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USSR REPORT

RESOURCES

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SOVIET NUCLEAR POWER BEING PROMOTED, SAID TO BE SAFE

Riga SOVETSKAYA LATVIYA in Russian 22 Jul 79 p 2

[Interview with Leonid Voronin, chief engineer of Soyuzatomenergo, by Lyubov' Sobolevskaya, of APN: "Nuclear Power--Today and Tomorrow"; passages enclosed in slant lines were printed in boldface and contain the interviewers' questions]

> [Text] The world's first nuclear electric-power station went into operation in our country 25 years ago. The APN [Novosti Press Agency] correspondent conversed with Leonid Voronin, chief engineer of Soyuzatomenergo--the All-Union Association for Nuclear-Power Engineering of the USSR Ministry of Power and Electrification--about how Soviet nuclear-power engineering has developed during the past quarter century and what its near-term prospects are.

"The first AES," says Leonid Voronin, "opened a broad path to the development of nuclear-power engineering not only in the USSR but also in the whole world. During these years we have converted it into an independent branch and it has become a most important factor in technical progress. Major experience in the design, construction and operation of large AES's has been gained. Soviet industry has mastered power units with capacities of up to 1 million kw. Two basic types of reactors--vessel and channel--with graphite moderator and boiling water as the heat-transfer medium have been developed and have passed practical verification. Power units with reactors of the first type are operating successfully at the Novovoronezhskaya, Kol'skaya and Armyanskaya AES's. Reactors of the second type have been installed at the Leningradskaya, Chernobyl'skaya and Kurskaya AES's, the capacity of each of the electric-power stations being 2 million kw.

"The operating experience of the Bilibinskaya ATETs [Nuclear Heat and Electric-Power Station] with water-graphite reactors and district-heating turbines is interesting. The Shevchenkovskaya AES with reactor based upon fast neutrons is operating. The installed capacity of our country's nuclear electric-power stations has reached 10 million kw."

/"Can you not briefly characterize the program for developing our country's atomic power engineering as a whole?"/

"In the USSR the production of electric power has doubled each decade, on the average. But the natural reserves of fossil fuels must be saved to the maximum, especially oil and gas reserves. Therefore the policy of developing primarily nuclear power, especially in the European part of the country, has been adopted. Large power-machinery manufacturing enterprises for the production of AES's, such as the Atommash plant, have been created or are under construction. Practice indicates that the AES is a reliable, economical and promising source of electricity. We will continue during the current and succeeding five-year plans to erect large AES's of 2-6 million kw capacity each, such as the Leningradskaya, Ignalinskaya, Kurskaya, Chernobyl'skaya, Smolenskaya, Yuzhno-Ukrainskaya, Kalininskaya and Rovenskaya AES's, with reactors having unit capacities of 1 and 1.5 million kw."

/"How is the problem of safety of nuclear electric-power stations being solved?"/

"For a quarter of a century we have been operating AES's successfully, paying paramount attention to their reliability and safety for personnel, the environment and the populace. We have created a system of state inspection for safety at all stages--from design to operation. The most competent and capable design organizations are doing the design work, and this fact provides for the most progressive constructional solutions.

"Designs for AES's call for a set of protective and localizing arrangements and systems for averting accidents, as well as measures that prevent the station's limits for radioactive products from being exceeded. Especially high demands are being laid on the level of operation. Engineering supervision over this has been centralized in the framework of the USSR Ministry of Power and Electrification."

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OBJECTIONS TO GEOTHERMAL POWER DISPUTED

Moscow PRAVDA in Russian 6 Aug 79 p 3

[Article by V. Reut: "...and a Lot of Water Has Flowed Under the Bridge"]

[Text] Returning to what was published previously.

"Once, about 20 years ago," writes P. Shvetsov, corresponding member of the USSR Academy of Sciences, "I was dreaming aloud about how soon the time would come when enough vegetables would be grown on Chukotka to feed the peninsula's entire population. But one of the local supervisory workers said:

"'Because of your indulging in hare-brained schemes, Chukotka can go without vegetables. Out of the blue they will stop shipping potatoes, cucumbers and tomatoes to Anadyr and to Provideniya Bay....'"

On what did the hydrogeologist base his not so unrealistic forecast? On the fact that in this rigorous district, with its permafrost and long winters, hot springs gush to the surface. If they are forced to serve the people, then even the unfriendly local ground will yield vegetables and fruits.

But still a clever man was found, who, reports the author of a letter, was not afraid of the "fantasticality" of the idea. He turned out to be G. S. Gutnikov, director of the Chukotskiy Sovkhoz imeni V. I. Lenin. He observed that a hot spring gushes in the vicinity of the central farmstead of the sovkhoz, pouring onto the surface each second about 50 liters of water at a temperature of 60 degrees, and he decided to adapt the heat source to the task. Now this water heats hothouses that grow vegetables and greens, which are precious on Chukotka, as well as housing, the dairy products department and the poultry house, and the sovkhoz's dispensary is now using it. A scientist has estimated that if other coastal settlements of the peninsula follow this good example, the hot springs can save millions of rubles annually.

No few responses to I. Dvorov's article, "Thermal Energy from the Earth," which was published on 15 December 1978, have arrived in the editorial

offices. Answers also were received from organizations that are involved in the use of thermal water.

Deputy Minister of Gas Industry M. Aratschev writes that the question of developing work to use the earth's deep heat has been raised correctly, in general, and the ministry is taking definite steps in this direction. Since 1972, the drilling for, and since 1975, the recovery of, thermal water have been concentrated in the Soyuzburgaz production association. Four specialized exploratory-drilling enterprises and five field administrations are performing these tasks. SevkavNIIgaz [North Caucasus Scientific-Research Institute for the Gas Industry] has developed a master scheme for using thermal water in the North Caucasus, Georgia and Stavropol'skiy and Krasnodarskiy krays. As for Siberia, the Far East and the Ukraine, broad searches should first be conducted here by the USSR Ministry of Geology. Mingazprom [Ministry of Gas Industry] will determine the regions to be developed in accordance with their results.

The reply indicated simultaneously that thermal energy is relatively cheap--but only apparently. Underground waters contain different salts, methane, hydrogen sulfide and toxic organic and inorganic substances, the discharge of which into open bodies of water is prohibited. The necessity to protect the environment makes it expensive to use the earth's heat.

Approximately these same difficulties are enumerated also in "supplementary information" sent out from the USSR Ministry of Geology. In June last year the ministry's board decided to consider geological exploration for thermal water as one of the most important operations and planned to conduct a major set of such operations during 1979-1985 on Kamchatka and in the Kurile Islands, the Georgian SSR, the North Caucasus and the BAM [Baykal-Amur Mainline] zone.

"The approach to solving problems of using the earth's deep heat should be well substantiated," the USSR Mingeo [Ministry of Geology] letter says further. And a master scheme for integrated use of the country's geothermal resources, the development of which is the task of Mingazprom (with the participation of other ministries and agencies, including potential customers), has been called a first step in substantiating it. Then the authors will consider the "information," and the geological exploration will rest on a more realistic basis.

It is clear from the answers that both the geologists and the extractors of the underground heat are striving to keep their hands on the pulse of a large and important problem. But its solution is poorly examined in these documents. For it is plainly visible that both the one and the other are striving to concede the initiative to the other for more intensive promotion of the work.

On instructions from USSR Minenergo [Ministry of Power and Electrification] managers, GlavNIIproyekt [Main Administration for Scientific-Research and Design Organizations] examined the article, "Thermal Energy from the Earth," about which the chief of this main administration, M. Pchelin, reported. He writes that the Pauzhetskaya geoTES [Geothermal Electric

Power Station], with a capacity of 5 megawatts, is now being expanded to 9.4 megawatts. In accordance with a Minenergo task, the Kamchatka Regional Geological Administration is exploring the Mutnovskoye field, at which the construction of a geoTES of 200-megawatt capcity has been proposed. But confirmation of the field's reserves is contemplated only in 1986, according to a Minegeo decision. Reserves of the Bol'she-Banyy field, the letter goes on to say, can be accepted into the inventory for the generation of electric power only when it has been determined that it is capable of using hot water with a high saline content. Technical and economic reports about the desirability of building two geoTES's with capacities of up to 1,000 megawatts each in Stavropol'skiy Kray and Zakarpatskaya Oblast have been completed. In brief, concrete actions for the coming year for power-engineering workers are limited to an expansion of the country's sole, small and only recently operated Pauzhetskaya geoTES. Further, the proposed construction is seen as somewhere in the not very near future.

There has been no reaction to what the agricultural ministries and agencies have to say. And it is they who would be able to make enormous use of this inexhaustible energy source, especially for the year-round growing of vegetables in glass-covered ground. Nor have managerial workers of municipal services expressed their opinion.

Geologists, gas-industry workers and power engineers blame everything on the high mineralization of thermal water, which causes equipment corrosion and environmental pollution. But, in the first place, not all underground hot water is saline, and there is also no small amount of fresh water. In the second place, the high degree of mineralization is not a fatal obstacle. Doctor of Mineralogical Geological Sciences A. Shcherbakov reports on a method for overcoming its "harmfulness."

"A few years ago," he writes, "a drill rig was drilling two wells under Paris. It turned out to be something like a compass with a long leg of about 3 km. The field proved to contain highly mineralized water with a temperature of 80 degrees. Heat exchangers were installed on the head of one of the wells, and an injection pump on the head of the other. The heat exchangers heated up fresh river water, which was used for the district heating of a settlement, and the cooled saline water was pumped back into the reservoir. And there was no pollution of the environment! According to specialists' estimates, such a circulation system will operate without reducing the temperature of the heat-carrier for about 30 years.

L. Balashov, laboratory manager of VSEGINGEO [All-Union Scientific-Research Institute for Hydrogeology and Engineering Geology], notes that it is expedient to use highly mineralized thermal water also as a raw-material source for obtaining rare and trace elements.

Unfortunately, we still have not developed an integrated approach to these gifts of nature. And the fault is not that of technological difficulties, which usually are given first priority, but of bureaucratic interests. The

power engineers and district-heating specialists do not need chemistry--give them a "pure" heat-transfer medium. The chemists are indifferent to thermal energy, they are responsible for extracting definite elements.

It is even more offensive when the riches of hot water are not put to use at all. Indeed, how many sources have been gushing idly from underground for years simply because no interested user has turned up. U. Akhmedsafin, director of the Institute of Hydrogeology and Hydrogeophysics and academician of the Kazakh SSR Academy of Sciences, and V. Zhevago, manager of a sector of the institute and doctor of mineralogical geological sciences, write that the scientists of that institute have found a number of large fields of thermal water in Kazakhstan. In places the hot water emerges at the surface and some wells have been pouring it out now for almost 10 years. Meanwhile, such remarkable fields as the Panfilov, Alma-Ata and Kyzyl Kum contain essentially fresh water with very slight mineralization. The temperatures of the water are up to 150 degrees in the area of the town of Panfilov, up to 65 degrees in the Alma-Ata area, and up to 100 degrees in the Kyzyl Kum.

The story can also be repeated in areas of the Baykal-Amur Mainline, where no few sources of hot underground water have already been found. New cities and industrial enterprises are growing up here and now is the time to be concerned about the heat energy of the earth's interior making its contribution to the economy's progress and to the amenities of the BAM zone. But again Siberia does not enter into the scope of interests of the specialized field administrations of Mingazprom. This means that everything here runs according to the principle, "Do it yourselves."

For a long time it has been said that use of the earth's heat is a complicated problem, that scientific research in the area of thermal-water chemistry and the extraction of useful substances therefrom must be strengthened, and that special equipment--heat exchangers, deep-well pumps and chemically resistant pipe--must be created and solutions obtained on how to deal with the spent water. Yes, this is necessary. Research is being performed at many scientific organizations, but it is isolated, without a unified plan. The matter of creating the equipment is moving still more slowly. For the problem has no authentic boss, one who is completely responsible for its comprehensive solution. In the opinion of G. Bogomolov, academician of the Belorussian Academy of Sciences, such a boss should be a substantial science-and-production association that is obligated to study comprehensively and to use the earth's heat throughout the whole territory of the Soviet Union. He proposed the creation of an association within the system of Mingazprom, which is already acquainted with the problem, but other ministries also would be involved in the execution of tasks. Doctor of Mineralogical Geological Sciences F. Makarenko and others support a similar point of view.

All the authors' responses to the article, "Thermal Energy from the Earth," agree that the time has come for those involved, including USSR Gosplan, to solve the problems connected with the study and use of thermal water. Substantial energy and raw-material resources are involved. It is important to put them into the national economy's service.

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ELECTRIC POWER AND POWER EQUIPMENT

TWO GEOTHERMAL POWER-STATION SITES SELECTED

Moscow TRUD in Russian 28 Jul 79 p 4

[Article by V. Ovcharenko (Kiev): "Electricity from under the Ground"]

[Text] The Soviet Union has begun to design electric-power stations at which power will be generated by underground heat that is stored at a depth of 4,000-5,000 meters.

Scientists at four of the country's largest institutes--the Power-Engineering Institute imeni Krzhizhanovskiy, the Kiev Section of Gidroproyekt [All-Union Design, Surveying and Scientific-Research Institute imeni S. Ya. Zhuk], the Institute of Thermal-Physics Engineering of the Ukrainian SSR Academy of Sciences, and the Leningrad Mining Institute imeni Plekhanov have joined forces to develop designs for high-capacity electric-power stations at which the earth's own heat, instead of coal, oil or gas, will generate energy.

Theoretically, everything seems to be simple. Two wells must be drilled down into the ground, where the heat reaches at least 200 degrees. Water has to be pumped through one well and it will emerge at the surface of the other in the form of steam that has been formed by the water's natural heat. This steam will have enough energy to cause an electric-power station to operate.

"But in practice, everything is much more complicated," says leading specialist of the Heat and Mass Transfer Section of the Institute of Heat-Physics Engineering of the Ukrainian SSR Academy of Sciences A. Shurchkov. "The heat in the ground is unevenly distributed in the earth's strata: in some places it comes close to the surface, in others it is hidden far in the depths. Drilling deep holes is time-consuming, labor-intensive and expensive work. But these are not the only difficulties. It is necessary also to find an underground void or those rocks that will play the role of unusual boilers, where the water will be transformed into steam. Moreover, it is necessary to have a source of water close by."

And so, as the result of lengthy exploration, the specialists have settled on two zones where it will be possible to build electric-power stations. One of these stations will be located in Stavropol'skiy Kray, the second in the Carpathians.

The initiators of the research have been assured that the first geothermal electric-power station will go into operation in Stavropol' at the end of the next five-year plan. Its capacity will be 1 million kw.

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ENGINEERS MEET TO DISCUSS NEW POWER-STATION DESIGNS

Leningrad LENINGRADSKAYA PRAVDA in Russian 20 Jul 79 p 2

[Article by Leningrad TASS: "Ways to Develop Soviet Power Engineering"]

[Text] Workers of the largest power-engineering machinery manufacturing enterprises and scientific-research and design institutes of Leningrad yesterday received the country's power engineers who arrived in Leningrad for an annual All-Union conference. This one is dedicated to the topic, "New Engineering Solutions to the Design and Organization of the Construction of Nuclear and Thermal Electric-Power Stations." The guests have become acquainted with the work of the Leningrad Metals Plant and Izhor Plant associations, the Northern and Southern thermal electric-power stations, the Leningrad Nuclear Station imeni V. I. Lenin and other enterprises and organizations.

After opening the conference, Deputy USSR Minister of Power and Electrification V. A. Kozhevnikov began a professional businesslike talk about the prospects for Soviet power engineering. He emphasized that, in accordance with 25th CPSU Congress decisions, a swing is being made in practice toward an accelerated development of nuclear power. It is necessary to provide for the introduction at AES's of 5-6 million kw of capacity per year. This task can be solved by the construction of units of high unit capacity. The production and operational assimilation of water-cooled water-moderated "millionaire" units are to be promoted, and the assimilation of equipment of the same capacity, of the multichannel type, must be completed.

A most important task of thermal power engineering is the creation of the Ekibastuz and Kansk-Achinsk power-engineering complexes. The conference also discussed the lessons of the past winter and noted tasks in the area of the operational stabilization of stations that supply heat for the city. In the long term is the creation of such stations that operate on nuclear energy.

On 20 July the conference participants listened to reports and communications on the most important scientific and technical problems.

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ELECTRIC POWER AND POWER EQUIPMENT

PROGRESS IN BUILDING SHALE-PROCESSING PLANTS TOLD

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 15 Aug 79 p 2

[Article: "Running in Place"; passages enclosed in slantlines printed in boldface]

[Text] Social correspondent posts report on the construction of installations for processing solid fuel into liquid and gaseous form.

SOTSIALISTICHESKAYA INDUSTRIYA has already written about the slow pace of erection of industrial-test installations--the ETKh-175 in Krasnoyarsk and the UTT-3000 in Estonia--and has taken these jobs under its monitoring. What has changed recently at the construction sites?

Krasnoyarsk

The serious criticism sounded from the newspaper's pages against the enterprises that are supplying the equipment has had its effect. The main building and the auxiliary facilities of the ETKh-175 industrial-test installation have been outfitted almost completely with operating equipment. There is an insufficiency only of load-lifting mechanisms, which should be shipped by Glavenergokomplekt [Main Administration for Outfitting Electric-Power Stations, Substations and Power Grids with Electric-Power Equipment] of the USSR Ministry of Power and Electrification.

Collectives of the Shchekino and Bagley plants for boiler-auxiliary equipment and pipelines, the Chelyabinsk machinery plant, and other USSR Minenergo [Ministry of Power and Electrification] and Minenergomash [Ministry of Electric-Power Machine Building] enterprises have acted conscientiously and with a feeling of responsibility toward the most important order of the Siberian power engineers. It would seem that now the situation should have changed sharply at the construction and installing site. However, the same as 3 months ago, a complete calm reigns here. /The plan for construction and installing work for the first half of the year has been fulfilled by 50 percent./ And in recent days only some auxiliary workers have been left on power-equipment installation jobs.

We asked the chief engineer of the SU [Construction Administration] for the Krasnoyarsk TETs's, N. Gur'yev, to disclose the startup schedule for the ETKh-175.

"There is no such schedule. We do not even contemplate startup of the installation this year," was the reply.

How is the frankly disdainful attitude of the Krasnoyarsk builders toward state-plan discipline explained? Comrade Gur'yev himself gives the answer.

"Officially the ETKh-175 is being counted as a facility due for startup for the second year," he stated in a conversation with members of the social correspondent post. "But in our ministry there is also an unofficial point of view on this score. We know thoroughly that no one has been especially exacting toward us because of a delay in startup of the industrial-test installation."

It turns out that perhaps there are two approaches to the fulfillment of plan tasks: the official and the unofficial. This seemed so surprising to us that, naturally, we asked for clarification about what the unofficial approach was. The chief engineer acquainted us with the minutes of a conference that Deputy USSR Ministry of Power and Electrification F. Sapozhnikov held in May this year, shortly after the SOTSIALISTICHESKAYA INDUSTRIYA article.

"After these minutes," explained N. Gur'yev, "it has been as if we were up against a stone wall. For it is written here in black and white: complete the shipment of equipment for the ETKh-175 installation, particularly for the coke and gas pipelines, in the first quarter of 1980. And that being the way the question is posed, it means that there will be no startup in 1979. On receiving the minutes, we cheered up and...all work on the industrial-test installation was cut down."

For a long time we tried to understand the minutes and the position of F. V. Sapozhnikov, but we could not do it. The ministry's managers, including, of course, Fedor Vasil'yevich himself, have done much recently to provide the construction project with equipment. But at the conference in May (and this was reflected in the minutes) he unambiguously required all managers of organizations subordinate to the ministry to take immediate steps to speed the startup of the ETKh-175 installation. On the other hand, there is the postponement of the shipment of the coke and gas pipelines. This undoubtedly has opened to the builders a loophole that enables them to evade fulfillment of the plan.

We think that the USSR Minenergo board will bring the job that has been commenced to an end and will take all the measures required for the ETKh-175 installation to begin to operate this year.

S. Yevtushik, senior engineer of ENIN [Power-Engineering Institute imeni G. M. Krzhizhanovskiy],

S. Yevdokimov, senior engineer of the ETKh-175 industrial-test installation, and
A. Ioganson, engineer of Krasnoyarskaya TETs No 2.

Tallin-Narva

There is a paragraph in our collective's socialist commitments about construction of the UTT-3000 industrial-test installation. The resources that we should assimilate have been pointed out. But nothing is said about startup. And indeed, according to the plan, we should turn the installation over for operation this year. How is such caution explained? A matter of a lack of confidence?

Not so much in our selves as in our suppliers. The world's first installation for transforming shale into liquid fuel and gas should have been put into operation back in 1978. But reinforced concrete, rolled metal and special equipment arrived here in inadequate amounts and they were late. This is why the plan deadlines for startup were shifted, and SOTSIALISTICHESKAYA INDUSTRIYA correctly criticized our delay. But this year the situation has changed appreciably.

After the intervention of the Central Committee of the Estonian Communist Party and the republic's council of ministers, the hope appeared that the Semiluki plant, which is located in Voronezhskaya Oblast and is our country's only manufacturer of silicon-carbide brick, would ship output to the Estonian power engineers in the third quarter of this year. For it is impossible to complete installation of the equipment without the special refractories.

Delivery of panels for the control positions also worries us. /At first Minelektrotekhprom [Ministry of Electrical Equipment Industry] assigned this work to one of the Leningrad plants. Then it released it from this important task and began to look for another source. And it is still searching./

We would like very much to start up the UTT-3000 installation this year. Much of the work is in the past. It is necessary that our suppliers do not let us down but allow us to cope with the task.

For a second month now the collective has been in a sweat because of a shortage of concrete, which a local Baltic plant sends us. Roads and the roofs of enormous storage facilities are not being built, and a large detachment of finishing workers is practically idle. We are in a hurry but it is like running in place. All this, in the final analysis, leads to crash work and threatens the deadline for turnover of the test facility.

B. Gamburg, chief of the electrical-equipment section of the Estonian GRES, and
I. Podkolzlov, brigade leader of the installing section of Sevzapenergomontazh [Trust for Installation of Power-Engineering Equipment in the Northwestern Economic Region].

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PROCESSING, STORAGE PROBLEMS WITH LIQUID RADIOACTIVE WASTES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 7, Jul 79 pp 9-13

[Article by G. V. Matskevich, engineer, All-Union Institute of Heat Engineering imeni F. E. Dzerzhinskiy]

[Text] An important technological link which determines the radiation safety of AES are special water purification (SVO) plants and also a system for gathering, processing, transport and storage of liquid radioactive wastes.

Processing liquid radioactive wastes includes:

producing water of such a degree of purity that would permit this water to be returned to the production cycle of the AES or discharge of it into external reservoirs;

concentration of the impurities retained from the water in the form of wastes which occupy a minimum volume and which are subject to special storage.

These problems should be considered only jointly when evaluating the technical perfection of the developed technology. According to recommendations of MAGATE [International Atomic Energy Agency], wastes are divided into five categories as a function of their radioactivity:

Category	Activity, Ci/kg	
1	$\leq 10^{-9}$	Weakly active wastes
2	10^{-9}-10^{-6}	
3	10^{-5}-10^{-4}	Medium active wastes
4	10^{-4}-10^{1}	
5	$> 10^{1}$	Highly active wastes

The following calculated amount of wastes is planned in designs of AES with VVER [Water-moderated water-cooled power reactor], for example, for the West German AES of the Biblis type with electric power of 1,300 MW.

Source and Type of Wastes	Activity, Ci/kg	Quantity, m^3
Wastes from special laundry, showers and chemical laboratories and wash waters from weakly active filters	10^{-7}	3000
Wastes from special laundry and chemical laboratories, wash waters and deactivation wastes	10^{-5}-10^{-7}	4000
Trap waters, wastes from units which clean the heat carrier, deactivation wastes and recirculated waters	10^{-3}-10^{-5}	9000
Heat carrier leaks and wastes from sampling systems	10^{-3}	100

Formation of radioactive wastes at AES is nonuniform in nature. Under conditions when the reactor is overloaded or when repair operations are being performed, the volume of wastes increase by a factor of 3-4 and under conditions when emergency situations occur, it increases by a factor of 10-20 compared to the normal operating period of the AES.

The main number of waste concentrators which are delivered for final storage in special containers is formed during purification of highly mineralized radioactive media. These media include trap waters, deactivation wastes, solutions after filter regeneration and also the runoff of special laundries and showers.

Improving the technology and purification of these media (we will arbitrarily call them trap waters) from the viewpoint of reducing the volumes of the wastes subject to special burial is of the most important significance. At the same time processing trap waters also presents the greatest technological complexity since the chemical composition of the initial water varies over a wide range and depends on which chemicals are used to deactivate the equipment and for regeneration of filters and also which chemicals are used as additives in the heat carrier, for example, boric acid.

Trap waters contain large amounts of foaming agents (soaps and detergents), scale formers (hardness salts and colloidal impurities), mineral oils, complexing agents, volatile solvents, ammonia and other chemical products capable of having a negative effect on the production process of purification and concentration. Moreover, after purification of such a complex medium in composition, one must produce water in which the concentration of radio nuclides and toxic chemical impurities is the minimum possible, i.e., below the maximum values established for media discharged into open reservoirs. The total

purification factor which is provided by the design should comprise 6-7 orders for trap waters.

The following methods of processing ZhRO [Liquid radioactive wastes] of the trap water type are now known:

coagulation, chemical precipitation and mechanical filtration. Purified water and radioactive pulp are produced as a result;

the method by the first item with subsequent prepurification of clarified solutions on inorganic sorbents having selective sorption to specific radio nuclides. In this case the spent sorbents which are usually sorbents of one-time use are additionally added to the wastes;

the method by the first item with subsequent total chemical desalinization of the clarified solutions on ion exchange filters. The reclaimed waters formed during operations of these ion exchange filters are wastes and require additional processing. The ion exchange resins which gradually lose their working properties also enter the wastes subject to burial;

the method by the first item with subsequent purification of clarified solutions on reverse osmosis or electrodialysis units. In this case pure water and wastes in the form of saline solutions are produced. However, the produced water must be additionally purified on ion exchange filters to provide high purification coefficients and to reduce the volumes of wastes and the saline solutions must be additionally concentrated by evaporation;

processing ZhRO on evaporators, after which a pure distillate and an evaporated solution (a still residue) with maximum possible salt concentration are produced.

The experience of operating an AES, which determines the amount of formed ZhRO, their composition and also the technique of storing waste concentrators, permits analysis of the prospects for application and development of the given methods of ZhRO processing. The most effective method of processing trap waters in the technical and economic sense was and continues to be that of using evaporator in combination with prepurification of the produced distillate on oil-removing and ion exchange filters. The relatively low volume of the trap waters, which reaches 5-6 tons/hr for AES with VVER and up to 20 tons/hr at AES with RBMK-1000 boiling-water reactors, the low cost of steam at AES (50-80 kop/t), the possibility of achieving the maximum purification coefficient (up to 6 orders) and the maximum degree of concentration of ZhRO and also the operational reliability of the evaporators developed by domestic industry, which are adapted for processing foaming waters, also predetermined the future use of evaporation as the main method of processing highly mineralized ZhRO at AES. A diagram of processing ZhRO using evaporators is shown in Figure 1.

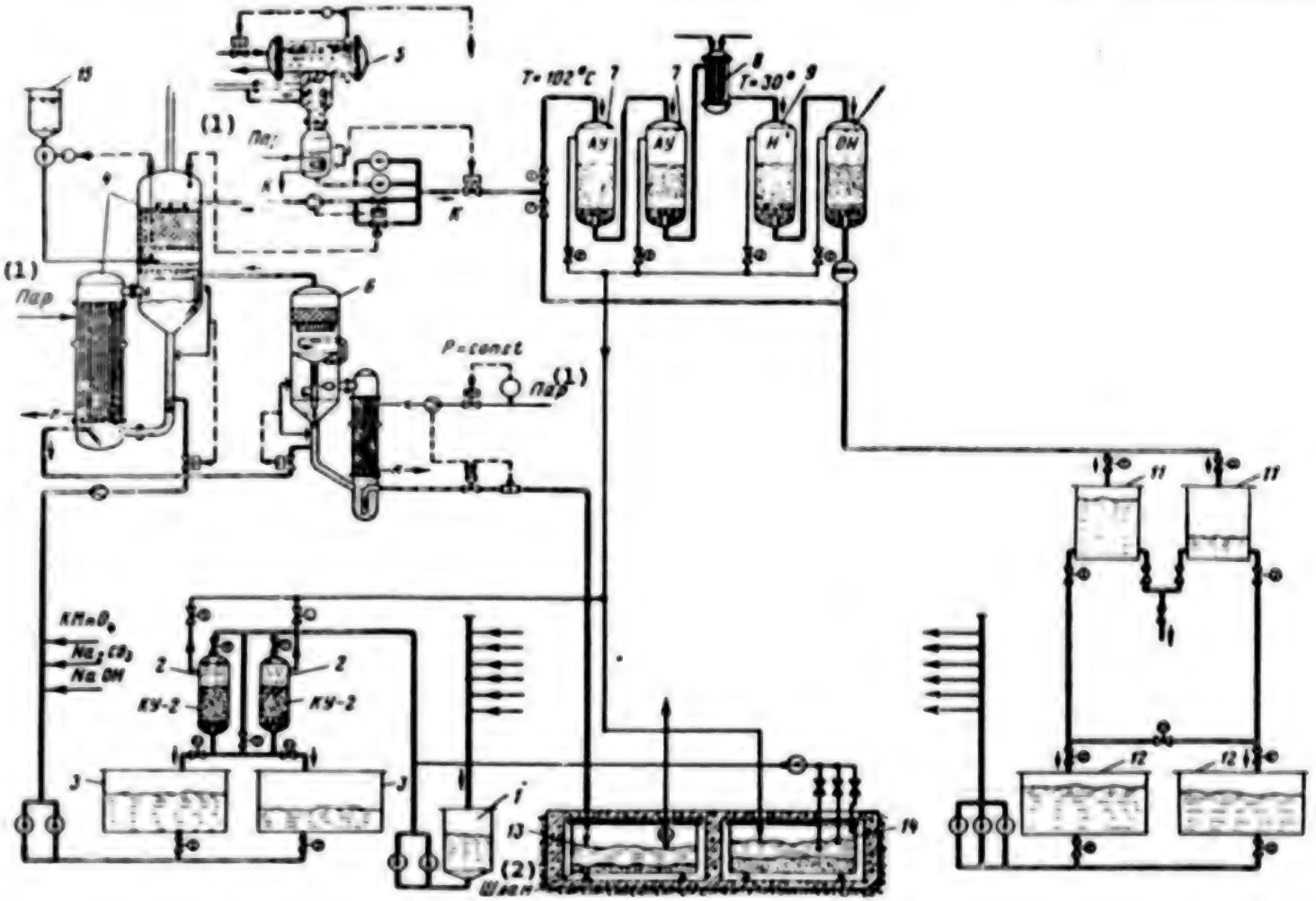

Figure 1. Process Flow Diagram of Processing Liquid Radioactive Wastes of an AES with VVER-440: 1 -- preliminary well; 2 -- mechanical filters; 3 -- trap tanks; 4 -- evaporator; 5 -- degassifier-condenser; 6 -- pre-evaporator; 7 -- oil-removing filters; 8 -- cooling unit; 9 and 10 -- ion exchange filters; 11 -- control tanks; 12 -- pure distillate tanks; 13 -- cubic residue tank; 14 -- settling tank for spent sorbents; 15 -- tank with foaming agent solution

Key:

1. Steam
2. Slurry

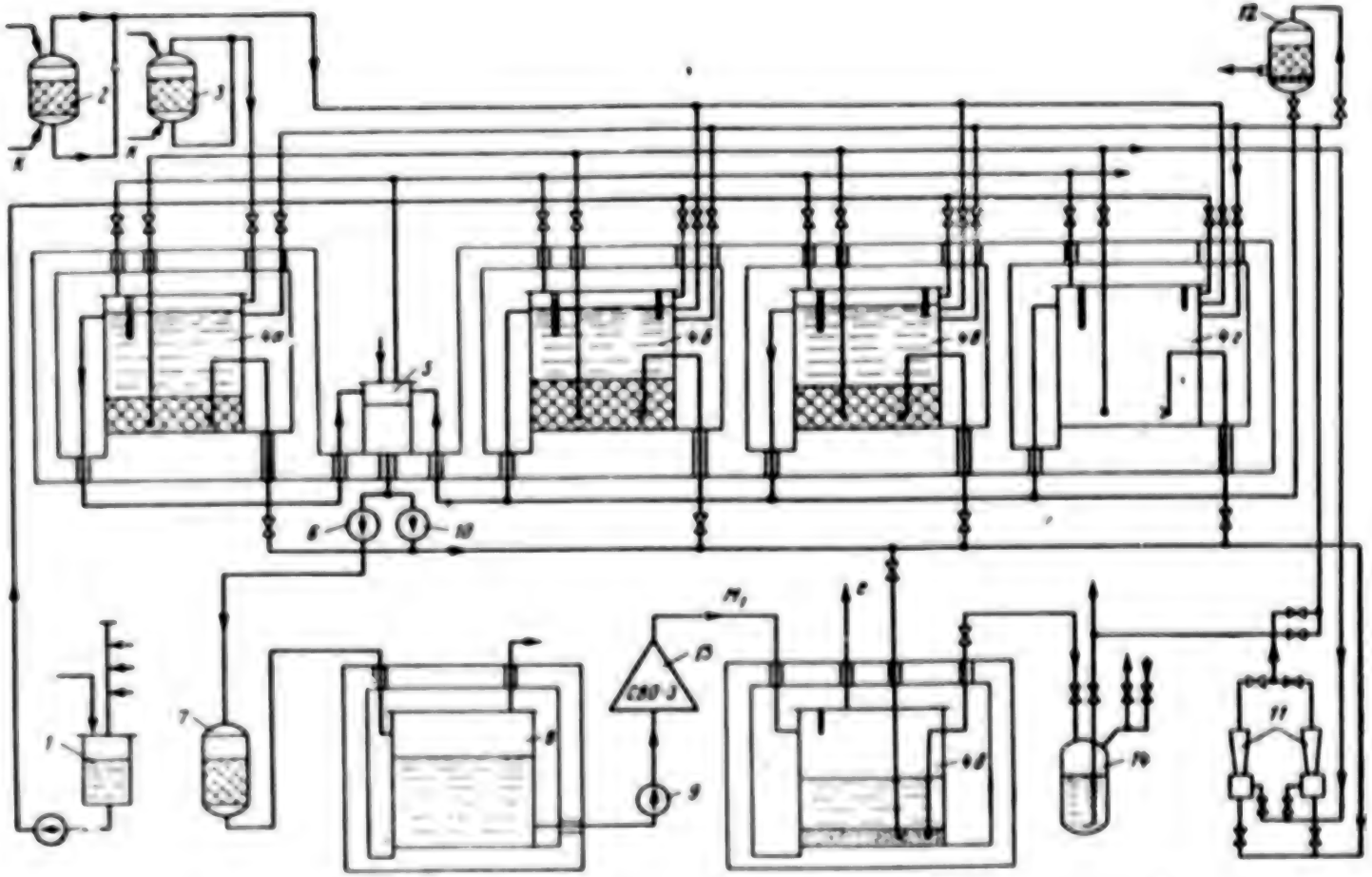

Figure 2. Diagram of Storage of Spent Ion Exchange Resins, Sorbents, Dispersed Radioactive Sediments and Still Concentrate at AES with VVER-440 Reactors: 1 -- intermediate tank for receiving trap waters; 2 -- highly active ion exchange special water purification filters (SVO); 3 -- medium active SVO filters; 4a -- tank for low active sorbents; 4b -- tank for neutralization and clarification of trap waters and medium active wastes from SVO units; 4c -- tank for reception, neutralization, holding and clarification of highly active regeneration solutions and sorbents; 4d -- reserve emergency tank; 5 -- intermediate tank for collection of clarified decanted solution; 6 -- pump for pumping decanted solution; 7 -- mechanical filter; 8 -- trap water tank; 9 -- pump for delivery of decanted solution to evaporator for processing; 10 -- pump for delivery of clarified water for washing pulp in tanks and to hydraulic lift; 11 -- hydraulic lift for pumping pulp; 12 -- container for storage of ion exchange pulp; 13 -- evaporator for processing trap waters and deactivated wastes; 14 -- air lift for pumping still residues to hardening system; 4e -- still residues tank

The method according to the second item is of interest for the runoff of special laundries, distinguished by high organic matter content (up to 1 g/liter) with relatively low radioactive chemical impurity content. The relatively high volumes the runoff of special laundries make it feasible to construct a separate unit at AES for processing these wastes.

The experience of operating AES makes it possible to distinguish the following important trends in improving production processes which directly or indirectly affect the yield of ZhRO:

introduction of optimum water-chemical regimes in the main circuit of the AES and more highly productive heat carrier purification systems capable of reducing the level of radioactive contamination of equipment and thus of reducing the use of chemical solutions for deactivation;

organization of collecting the flows of boric acid solutions with return of these flows to the purification system and regeneration of the boric acid (at AES with VVER);

improving the technology of chemical deactivation of equipment: use of high-temperature deactivation methods with minimum concentration of chemical substances in the solution, the use of electrochemical and steam-ejection deactivation and purification of deactivating solutions for multiple use of them;

an increase of the interregeneration operating cycle of ion exchange filters in distillate prepurification circuits after the evaporators by increasing the effectiveness of ammonia distillation during degassification of the distillate (at AES with VVER-440); increasing the effectiveness of distillate purification of mineral oils and volatile organic products (at AES with RBMK-1000); and increasing the degree of regeneration of anion exchange filters by using warm and clean alkali solutions;

improving the schemes of purifying the turbine condensate (at AES with RBMK-1000) and namely introduction of combination schemes which include, besides bulk, FSD, washing ion exchange filters which prevent the formation of volumetric regeneration wastes; increasing the efficiency of the separation process of the ion exchange charge of the FSD prior to regeneration; and increasing the degree of regeneration of the anion exchange resin by using only warm alkali solutions with minimum chloride content;

developing more improved technology for processing the wastes of special laundries and sanitary passages.

Reception and intermediate storage of the waste concentrates. Two types of concentrators, differing in their properties, are mainly formed during treatment of ZhRO: ion exchange resins in a mixture with other absorbents and dispersed residues and saline concentrates or still residues. Yet another type of wastes -- slurries and hydroxide pulp -- also occurs in relatively large

volumes in circuits where methods of coagulation, precipitation and also washing filters are used for purification of ZhRO.

A diagram of storage of liquid waste concentrates (KhZhO), which is the basis for the design of domestic AES with VVER-440 is shown in Figure 2.

Tank 4b in the indicated diagram is used for reception, neutralization and clarification of trap waters and medium active wastes from ion exchange filters (wash water, regeneration solutions and also spent resin). Tank 4c is usually employed only to receive highly active wastes after filters 2, which serve to purify the heat carrier of the first circuit. The design of tank 4 provides containment of the solutions, effective separation of the dispersed phase from them and permits return of the neutralized and clarified decanted solution, cleaned of suspensions, to the production cycle. Filtration of the decanted solution through filter 7, which is charged with a cation exchange resin, permits additional cleaning of the decanted solution of fine radioactive suspension and thus makes it possible to prevent accumulation of residues in the trap water tanks.

The technology which provides optimum use of resin regeneration methods in combination with treatment of regeneration solutions by methods of neutralization, settling and containment of neutralized solutions to an alkaline reaction in contact with spent resins, makes it possible to concentrate the main amount of radio isotopes in the ion exchange pulp which occupies a small volume in a mixture with other inorganic residues. Subsequent treatment of decanted solutions on an evaporator permits production of a still residues solution whose radioactive component is determined mainly by nuclides of cesium 137 and 134. The relative increase in the volume of the still residues, which occurs in the considered technique due to the use of multiple regeneration of ion exchange filters, is more preferable since an increase of the fraction of wastes in the form of an ion exchange pulp, whose volume increases to a relatively large degree if the resins are not regenerated. The calculated planned amount of waste concentrates for an AES with two VVER-440 blocks during a year is presented below:

	Volume of Wastes, m^3
Low active (10^{-6} Ci/liter) resins with slurry (Tank 4a)	16-20
Medium active and highly active resins in a mixture with hydroxide residues and slurry (Tanks 4b and 4c)	50-60
Still residues (Tank 4e)	200-250

Conservative input data are the basis for calculating the given values. Actually, the volume of wastes, as indicated by the experience of operating AES, is significantly lower.

The radioactive resins, absorbents and dispersed residues stored in tanks 4 are constantly under a water layer, which increases their storage safety and simplifies the process of subsequent transport of the pulp to the hardening system. The system is designed such that in case the working tank is damaged, the wastes can be remotely transferred to reserve tank 4d. Hydraulic lifts 11 are used to transport the pulp from tank to tank and also from the tank to the waste hardening system and airlift 14 is used to transport the still residues. All the tanks are located in sealed concrete rooms lined with corrosion-resistant materials to prevent accidental leakage of the solution to the external systems.

The water-chemical mode in the tanks is organized so as to:

prevent corrosion damage of austenitic steel from which the tanks are manufactured;

prevent the danger of salt crystallization and corrosion of transport communications by them;

reduce to a minimum the formation of volatile forms of chemical and radiochemical substances;

prevent adhesion of resin particles and cementation of dispersed residues by maintaining the mobility of the stored residues;

eliminate the possibility of microorganisms developing during the vitality of which fuel gases or enzymes which lead to cementation of the residues are formed.

A highly alkaline chemical regime with simultaneous presence of organic surfactants (detergents) in the stored media corresponds to the greatest extent to the indicated requirements. The KhZhO scheme is constructed such that the detergent solution or another chemically active solution can be specially delivered to tank 5 if necessary and from it by pump 10 to the lower part of tank 4 (through the jet washing device).

The calculated composition of the still residues and of the ion exchange pulp in tank 4c for the most typical chemical and radiochemical components for an AES with VVER-440 is presented below and in the table.

Компоненты (1)	(2) Характерный радиохимический состав отходов после выдержки в течение года, Ки/кг					
	(3) Общая активность	Co^{60}	Zr^{95}	Ce^{144}	Cs^{137}	Cs^{134}
(4) Катионит без учета коррозионного шлама, отделенного от смолы	1,0	0,03	0,1—0,2	0,1	0,5	0,3
(5) Анионит без шлама	0,2	0,01	0,05—0,1	0,1	—	—
(6) Коррозионный шлам	15	3	5—10	3,0	—	—
(7) Декантат кубового остатка	0,005	$1 \cdot 10^{-3}$	$5 \cdot 10^{-3}$	$1 \cdot 10^{-3}$	$4 \cdot 10^{-3}$	$1 \cdot 10^{-3}$
(8) Шламовый составляющая кубового остатка	$2 \cdot 10^{-3} + 5 \cdot 10^{-3}$	$2 \cdot 10^{-3}$	$5 \cdot 10^{-3} + 1 \cdot 10^{-3}$	$3 \cdot 10^{-3}$	$4 \cdot 10^{-3}$	$1 \cdot 10^{-3}$

Key:

1. Components
2. Typical radiochemical composition of wastes after confinement for 1 year, Ci/kg
3. Total activity
4. Cation exchange resin without regard to corrosive slurry separated from the resin
5. Anion exchange resin without slurry
6. Corrosive slurry
7. Decanted still residues solution
8. Slurry component of still residues

The typical chemical composition of the still residues is:

	Content, g/liter
Total salt content	300-400
Sodium and potassium nitrate	200-250
Sodium oxalate $Na_2C_2O_4$	25-28
Boric acid compounds calculated for $Na_2B_4O_7$	50-60
Sodium carbonate Na_2CO_3	20-25
Caustic soda NaOH	25-30
Organic substances, including surfactants	30-40
Suspended substances (slurry)	5-10
Content of dry matter in the packed slurry layer	200

It should also be noted that the maximum permissible salt concentration in the still residues is determined by the specific content of boric acid compounds in it. For example, if this content increases from 15 percent twice, i.e., up to 30 percent, the permissible total salt content of the still residues is limited by a value of 150-200 g/liters.

Final processing of the waste concentrates. The concentrates produced in treatment of wastes should be converted to a final form for burial so that

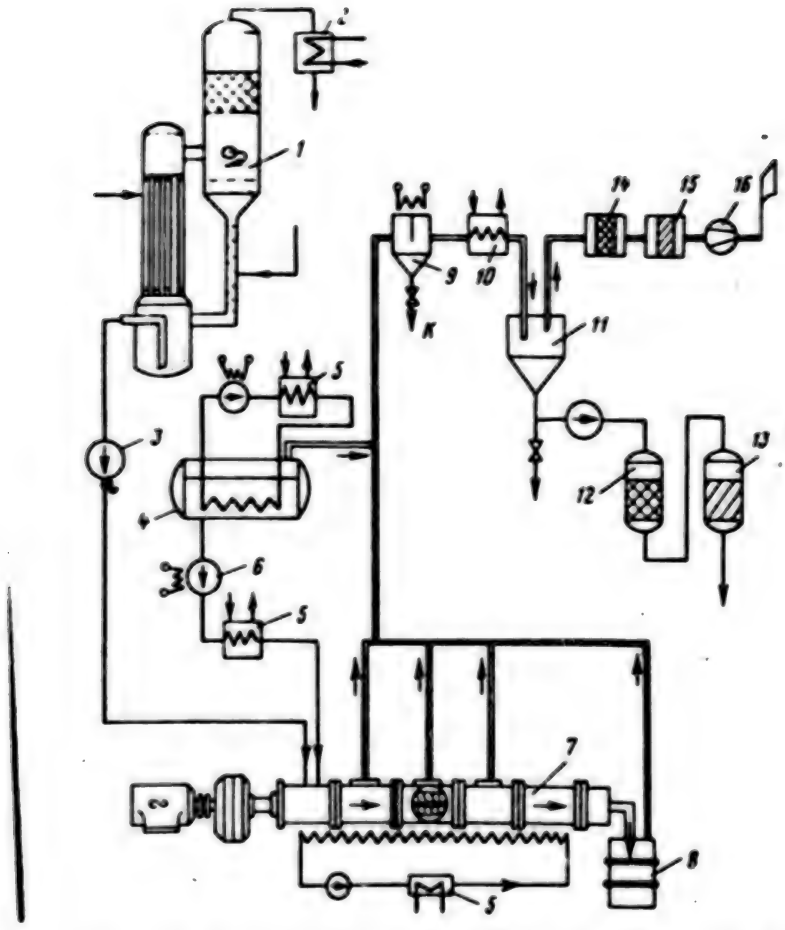

Figure 3. Diagram of Installation for Bituminization of Liquid Waste Concentrates: 1 -- pre-evaporator; 2 -- vapor condenser; 3 -- evaporated concentrate proportioning pump; 4 -- molten bitumen tank; 5 -- vapor heater; 6 -- molten bitumen proportioning pump; 7 -- two-channel pug mill with thermal heating; 8 -- container (barrel of 200-300 liters) for receiving the bitumen mixture; 9 -- moisture separator; 10 -- cooling unit; 11 -- contaminated condensate collector; 12 -- activated charcoal filter; 13 -- mechanical filter; 14 -- wood charcoal filter; 15 -- aerosol filter; 16 -- gas blower.

this final form, being subjected to the effect of the environment (water, air, light, microorganisms and so on), remains stable in the chemical, radiochemical, thermal and mechanical sense.

To do this, the following methods are used at AES.

The liquid concentrates are hardened by mixing them with substances which bind the water. This method is known as "cementation" since cement is most frequently used to bind the water residues. The produced cement-salt mass is also poured into containers (barrels) where it hardens. The cement blocks are stored in special dry storehouses. The given method makes it possible to produce a more stable and inert product in the chemical sense and consequently to increase its storage safety. However, the volume and mass of the final product are increased with this method, which increases the cost of processing, transport and storage of the wastes. Moreover, migration of radio nuclides to the environment is not completely excluded during prolonged storage of the cement-salt mass and upon its contact with water.

The liquid concentrates are hardened by mixing them with inert viscous fillers and with simultaneous evaporation of the residual moisture. The use of bitumen as the filler has become most widely used. The pre-concentrated solution or condensed pulp is delivered together with the fillers to a pug mill heated with steam. Multipass pug devices whose profile creates a good mixing action and provides self-cleaning of the rotating surfaces and deactivation of them after completion of work, are usually employed as the mixer. The moisture is evaporated during mixing at high temperature (120-150°C) and the salts and slurry are uniformly dispersed in the bitumen with formation of a homogeneous mass which is then poured into a container. The mass cools in the container and congeals to a solid monolithic product (compound) having moisture content not greater than one percent and containing up to 50 percent salts. A diagram of this process is shown in Figure 3 and it is now used extensively. The disadvantages of this method are the capability of the produced blocks to burn and consequently the need to develop firefighting measures during storage of large volumes of wastes and also the relatively high cost of the process.

The use of high-temperature processing, as a result of which the moisture, organic substances, nitrates and carbonates are broken down and volatilized while the inorganic oxides, becoming mixed with the special additives (fluxes) are melted and converted to a vitreous mass. The produced mass has higher chemical and physical stability and is capable of reliably confining the radio nuclides within it. The disadvantage of the method consists in formation of large quantities of volatile products, including radioactive products and also the high energy expenditures.

Proper selection and industrial use of one or another methods of processing radioactive wastes for long-term and safe burial of them is of important significance during design and operation of atomic power plants.

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CSO: 1822

REPLY TO 8 JUL 'SOTSIALISTICHESKAYA INDUSTRIYA' ARTICLE ON BELOYARSKAYA AES

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 15 Aug 79 p 2

[Article by special correspondent A. Mal'tsev: "But What Kind of Relationship is This?"]

[Text] In July of this year, an article entitled "When Partners Let You Down" was published in SOTSIALISTICHESKAYA INDUSTRIYA. It said specifically in it: "Matters are worst of all at the Leningrad Plant Elektropul't with deliveries for the Beloyarskaya AES. This enterprise is interrupting scheduled shipment of panels."

And now the editorial board has received a brief answer from Elektropul't, but full of optimism: "In response to the article 'When Partners Let You Down,' we report that the plant collective has completely fulfilled deliveries for the Beloyarskaya AES in June of 1979, provided by the joint socialist pledges with the builders."

Let the reader not rush to praise the plant. There is no truth in several lines of the answer. The last two rail cars with control panels, as is obvious from the railroad invoices, were shipped to the Beloyarskaya AES in July rather than in June. All orders for the BN-600 block were fulfilled with a delay from 15 days to 1.5 months compared to the schedule confirmed in April by the deputy minister of the electrotechnical industry V. Borushko.

And this is not all. The construction project received products that were not complete. There were no transformers, starters and other equipment in 50 panels. This is one-third of the total amount provided for shipment to the Beloyarskaya Atomic Power Plant in April, May and June by Elektropul't. It turns out just how poor the relations still are! The plant managers were too fast in talking about fulfillment of their pledges.

The director of the Leningrad Plant Elektropul't Yu. Sokolov deliberately signed the unobjective answer. It is difficult to say what guided him: whether it was a desire to defend his regimental honor or something else which we cannot even guess at. The party committee of the enterprise was supposed to look into all this. But strange as it may seem, its secretary

I. Prokof'yev could find nothing better to do than to place his signature alongside the director's.

The managers of the equipment section of the Beloyarskaya AES begged us in one voice not to write about Elektropul't. After all, if you offend the director you won't be able to force out the missing complete units from him. Is not one of the reasons which create the soil for violation of state discipline of deliveries concealed in this timidness and all-forgivingness? Is confidence in those guilty of deceit going unpunished not confirmed in this?

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ELECTRIC POWER AND POWER EQUIPMENT

800,000 KILOWATT TURBOGENERATOR DEVELOPED AT ELEKTROSILA

Moscow IZVESTIYA in Russian 18 Aug 79 p 3

[Article by Academician I. Glebov, director of the All-Union Scientific Research Institute of Electric Machine Building]

[Text] Bench tests of a turbogenerator with capacity of 800,000 kilowatts with complete water cooling have been successfully completed at the Association Elektrosila. This design goes far beyond the bounds of ordinary technical improvements and opens a new stage in development of Soviet electric machine building.

I would like to recall that more than 80 percent of the electric energy in the world is now produced by turbogenerators. Their specific weight will increase even more with regard to the extensive program of atomic power plant construction.

Development of an energy base requires that industry create ever more powerful energy blocks. However, this taks cannot be solved by simple repetition of the previous design with an increase of dimensions. An increase of the overall dimensions of machines is limited by the conditions of the strength of materials, the production capacities and transport of gigantic subaseemblies which weigh hundreds of tons. A sharp increase of the unit capacity of turbogenerators with minimum variation of dimensions is the main problem, on which scientists and engineers-electric machine builders are working. Moreover, one of the main difficulties is efficient cooling of the turbogenerator, that is, in providing normal thermal operating mode of all components and primarily of the numerous conductors, soldered joints and insulation. Let the reader imagine that 10,000 electric hotplates rated at 1 kilowatt each have been assembled and switched on simultaneously in a room with area of approximately 30 square meters. This is the heat release in a modern turbogenerator with capacity of 800,000 kilowatts. It would simply melt and burn up without intensive cooling.

When the capacity of turbogenerators did not exceed 100,000 kilowatts, air circulated inside by means of blowers coped successfully with the task of cooling. The duties of cooling agent were then turned over to hydrogen,

which removes heat much better than air. And its density is ten times less. As a result, losses to friction are reduced and the efficiency of machines is increased. The next step was to develop turbogenerators with air-cooled high-voltage stator windings where distilled water, which is a dielectric, is fed through the insulating pipes into hollow copper conductors of the winding and is discharged to the outside through the same insulating pipes. All the remaining parts of the turbogenerator are cooled by hydrogen. This cooling principle is used in domestic turbogenerators with capacity from 200,000 to 1.2 million kilowatts and in powerful turbogenerators of many foreign companies. At the same time, the entire world is working intensively to develop turbogenerator designs where all components are cooled with water.

The thermal conductivity of water is threefold and its specific heat is 3,500 times higher than that of hydrogen. The use of this effective cooling agent permits a significant increase of the load and unit power of turbogenerators and an improvement of the thermal and electromagnetic characteristics. Moreover, servicing of these machines at the electric power plant is considerably simplified since there is no need for a large and complex system of safety measures which are necessary when working with explosive hydrogen.

The main difficulty standing in the path toward implementation of this idea is development of a reliable water-cooled rotor. After all, water must be delivered to a shaft rotating at a speed of 3,000 revolutions per minute, admitted through the winding under enormous centrifugal forces, vibration and pressures reaching several hundred atmospheres and again removed from the shaft. The design is complex and laborious to produce.

The scientists and engineers of Elektrosila looked at the problem in a new way: if there are components which complicate the design and which make it less reliable, then they should not be improved, but eliminated altogether. This simple and original approach made it possible to completely resolve all the difficulties. A so-called self-delivery system in which the water, running out of the shaft, is poured into a rotating collector in a free stream, is driven along the winding from the outsdie by centrifugal forces without pressure and is discharged into a water-collecting header, was developed. All the tubes connecting the hollow copper conductors with the shaft are absent, the water pressure in the winding channels is 3 to 4 times less than in traditional systems and the possibility of water leaks is eliminated. At the same time a water cooling system for all the other components of the turbogenerator: core, housing, end panels and carbon brushes, was also developed. This made it possible to completely do away with the use of hydrogen.

The first experimental turbogenerators with complete water cooling, manufactured by the Elektrosila Association, had a capacity of only 60,000 kilowatts, but they immediately showed the enormous advantages of the new design: lower weight compared to hydrogen generators of the same capacity (80 tons instead of 125 tons), lower heating of active parts, high maneuverability,

that is, insensitivity to frequent starts and stops, variation of modes and overloads. The generator immediately replaces four types of serial hydrogen generators designed for different voltages and rotational speeds. Two of these machines are already operating at the Leningradskaya TETs No 2 imeni Leninskiy Komsomol.

It should be especially noted that not a single failure of the water systems has occurred during the entire 14 year period of operation of the three experimental turbogenerators with complete water cooling, which indicates their exceptionally high reliability. This permitted the electric machine builders to decide to design and manufacture an experimental turbogenerator with capacity of 800,000 kilowatts. Its dimensions and energy parameters were taken the same as in the serial "800-kilowatt unit" with hydrogen-water cooling and many subassemblies which had shown their reliability under long operating conditions were retained for purposes of interchangeability and simplification of development in production. Despite this, the problem was complex and related to new scales of capacity, heat, speeds and centrifugal forces and electrodynamic effects on the windings.

A water-cooled damper winding on the rotor, which improved cooling of the rotor and the gas in the gap and which increased the operating stability of the generator in the energy system, was additionally introduced in the new turbogenerator and a number of crucial subassemblies was redesigned to increase the electric strength of the winding installation and to reduce the heating and vibration of the rotor and stator. Filling the stator with inert gas (nitrogen) at atmospheric pressure was provided to improve the operation of the high-voltage insulation.

The work, which was headed by the All-Union Scientific Research Institute of Electric Machinebuilding, was carried out on a wide front. Scientists and investigators labored intensively along with the designers. New materials were sought, mockups and models of the new subassemblies were tested, the technique of manufacture and assembly of them was developed and theoretical justification of the new design solutions was carried out.

Last year the turbogenerator was manufactured. The next step was testing and finishing it on a unique test stand, which permits tests not only on no-load but also under load. The design has now been developed in all respects: electromagnetic, thermal and mechanical. The generator successfully passed the final stage of testing, including prolonged conditions at nominal load of 800,000 kilowatts. The best worldwide advances have been surpassed in the level of heating and vibration and the generator is capable of carrying a load up to 1 million kilowatts with nominal power coefficient and high efficiency.

The Interagency Committee on Acceptance of the turbogenerator evaluated the conducted sicentific research and experimental design work with the highest category of quality. Representatives of the Ministry of Power Engineering and Electrification of the USSR noted the high operational advantage of the

turbogenerator with complete water cooling due to its high maneuverability, the absence of hydrogen, blowers and oil seals of the shaft and simplification of servicing and monitoring. The use of these machines will make it possible to produce energy blocks at electric power plants that are completely explosion- and fire-safe. The joint decision of two ministries (the Ministry of the Electrotechnical Industry of the USSR and Minergo [Ministry of Power Engineering and Electrification of the USSR]) has now been signed on installation of this generator at the Ryazanskaya GRES for experimental operation. Startup of it is planned for next year. Manufacture of yet another generator for this same electric power plant is also provided.

All the main theoretical developments and design solutions embodied in the new machine have completely justified themselves. The enormous volume of measurements and information obtained during tests of the 800-thousand kilowatt turbogenerator with total water cooling makes it possible to gain precise idea of the operation of all systems and to confidently predict the behavior of the generator during operation. The new design surpasses the worldwide level by many years, which creates a corresponding advantage to Soviet electric machinebuilding in the given field of technology and opens up great prospects for a significant increase in the quality and reliability of turbogenerators, their competitiveness on the worldwide market and a systematic reduction of laboriousness and materials consumption. The possibility of developing machines with capacity up to 2-2.5 million kilowatts has been opened up.

Further development of the problems discussed here is an important scientific and practical task faced by the national economy. However, one can already say that successful completion of the tests of the "800-kilowatt unit" with total water cooling will make it possible to solve the problem of providing Soviet power engineering with superpowerful reliable turbogenerators that are convenient to operate.

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CSO: 1822

FUELS AND RELATED EQUIPMENT

INFORMATION ON USSR LWR REACTORS PRESENTED AT SEMINAR

Tokyo GENSHIRYOKU SANGYO SHIMBUN in Japanese 28 Jun 79 p 4

[Article by Ryoseki Mishima: "USSR LWR Technology in Relief"]

[Text] The Soviets are still highly concealed under a bell of secrecy where nuclear power development is concerned. This ring of secrecy was slightly dented during the recent seminar of nuclear power specialists held recently between the Japan Atomic Industrial Forum and the Soviet Atomic Power Utilization National Committee. After offering a truly large number of results, the Soviets pulled down the curtain, but there were still "many unexpected developments." We asked Professor Yoshinori Mishima of the University of Tokyo who served as one of the Japanese delegates to describe mainly items and subjects in the Soviet papers that he considered noteworthy.

A Japanese observation group on nuclear industry was dispatched to the Soviet Union last fall, and through cooperation with the national committee on atomic power utilization it firmed plans for this first seminar whose theme was the light water reactor fuel technology that was held on the 19th and 20th at Tokyo.

The Soviet specialists present at this seminar numbered five men headed by Dr I. S. Gorobunin, chief of the Nuclear Fuel Research Department of the Soviet Union Inorganic Materials Research Laboratory while their Japanese counterparts were the seven specialists headed by Professor Mishima as spokesman.

This seminar extended over 2 days with three sessions being held each day (one in the morning, two in the afternoon) for a total of six sessions. There were six papers presented by each side. I chaired the first day's sessions in which there were alternate Soviet-Japanese papers presented. Dr Gorobunin represented the Soviet side in chairing the second day's sessions in which alternate Japanese-Soviet papers were presented. These papers were of 10-30 minutes duration.

What was noteworthy of this seminar was that, unlike Soviet presentations in the past, there was considerable data offered from the Soviet side. At the

same time, they responded readily to questions. As a result, I can say from my experiences at a number of technological sessions with the Soviets in the past that this was an occasion when the Japanese were able to obtain the most information.

Fuel Damage Rate "Average" for Soviet Reactors

The discussion below will touch very lightly on the Japanese papers and every effort will be made to expand on the gist of the Soviet papers and particularly on new information.

The first session was titled "Outline of Standard Type Light Water Reactor and Fuel," and the Soviet presentations were led off by Gorobunin himself while Mr Seishi Hisake of the Japan Atomic Power Company was the first Japanese speaker who spoke on "Outline of Standard Type Light Water Reactor in Japan and Its Fuel Design."

The Soviet paper discussed their representative light water reactors RBMK-1000 and -2500 (with respective outputs of one million and 1.5 million KW respectively) and the VVER (or WWER) -1000 and their fuel elements. The RBMK is graphite moderated boiling light water cooled pressure tube type, and this type of reactor already possesses a long operating record with 2 million KW class reactors already operating in Leningrad. The core is a 3.5 meter 2-layer structure 7 meters long whose fuel elements are 3,644 meters long and with effective length of 3,430 mm. The fuel cladding and the plugs for the two ends are 1 percent niobium-zirconium alloy that goes under the name H-1 alloy. The plenum volume is 9 percent, and the pellets are said to have LD of about 1 percent. In contrast, the VVER 1000 is a pressurized water type whose core is a 3.12 meter diameter hexagon. Its fuel is deployed in a hexagonal pattern, and each fuel element is 3.5 meters high. There are 151 fuel elements. There are 317 fuel rods in each of the fuel assemblies, and each fuel rod is 3840 mm long, has plenum volume of 16 percent, is sealed in under 20-25 kg helium pressure, and its cladding thickness is said to be 0.7 mm. The cladding material is H1, and this alloy is also used by P and B.

The essential features of these two types of reactors were described in considerable detail. The fuel manufacturing process is not much different from that of Japan in that the O/U ratio of the pellets range from 2.000 to 2.015, and the permissible impurities levels are 50 ppm fluorine and 10 ppm water. The fuel cladding tubes are finished with an acid wash, the pellets are packed, the end plugs are inserted, and the tube is sealed. They then place the fuel rod into an autoclave and this is where both the Japanese P and B reactors differ.

The theme of the second session was "Fuel Use Records." The Soviet paper was presented by E. Yakshin titled "Leakage of Nuclear Fission Products from the Fuel Rods of Soviet Boiling Water Reactors" while the Japanese paper was presented by Mr Noboru Morioka of Kwansai Electric on the use of light water reactor fuels in Japan.

Where almost mythical rumors had it that the Soviets suffered not one instance of damaged fuel, it was stated in one of these papers that they experienced about one percent or even higher rate of fuel damage at the outset, and the presentation of such quantitative information should be noted very well.

These revelations were prefaced with the statement "the causative factors were as all of you assembled here today are aware," and their texts indicated hybriding, iodine corrosion, PCI (pellet-cladding interaction), and manufacturing shortcomings to be the causative factor just as is experienced at any other nuclear power facility. They claimed it was easier to study the release of FP from damaged fuel in the boiling water type reactor, and they offered data from the VK-50 that was the predecessor of the RBMK. During one of the discussion periods, they offered data that was essentially the same as that given by Mr Ikegame of Tokyo Electric on the Fukushima Power Plant BWR. Ikegame's data was compared with data offered by Galoglianov, Gundlemigen, and Dresden, and the Japanese data indicated the rate of fuel generated leaks to be very low recently. This was also pointed out at the conference of fuel specialists sponsored by IAEA and held at Aruru in France during the middle of May (IWGEPT) where the present status of fuel generated leaks in Japan was shown to be very low compared to the United States, Europe, and the Soviet Union, and the radio-activity concentration in the reactor water was roughly two orders of magnitude lower in the Japanese reactors. In line with these results, the question came from the Soviets inquiring about the factors responsible for the fuel produced in Japan being much superior compared to fuel imported from the United States. The answer given was that quality control was exercised to a higher degree in the Japanese fuel production plants. When the method of calculating the 0.1 percent rate of damage to fuels for Soviet reactors, the answer was that no direct count of damaged fuel was possible, and this figure was arrived at using calculations based on the quantity of radioactivity that leaked out.

Soviets also Seek Economy--Development of New Fuels

The third session was titled "Evaluation of Fuel Behavior during Operation and Design of New Type Fuels," and the Japanese side was led off by Mr Hironori Ono of the Central Research Institute of the Electric Power Company with the talk under the heading "Evaluation of Fuel Behavior during Operation" in which he introduced Japan's fuel behavior code. In its presentation, the Soviets were again represented by representative Gorobunin who reported on the subject "Policy to Improve Reliability of VVER and RBMK Fuel Elements." In this paper he described the history of the Soviet efforts in improving the fuel for light water reactors. Although there was no outstandingly new information, he reported the rate of damage to fuel elements of the VVER-440 during 1977 to be 5 in 10,000. In order to prevent so-called densification, the density of uranium dioxide is kept above 10.4 and commonly between 10.5 and 10.6, moisture content to less than 3-5 ppm, and densification rate less than 2 percent, and the stack length of helium pressurized VVER fuel contracted 3-20 mm. What was interesting here was their addition of ammonia and potassium salt to the light water in order to

improve hydration property, and this addition lowered the corrosion of H1 alloy cladding to a considerably lower level, and it was claimed that adhesion of aqueous slime to cladding also was reduced considerably.

Gorobunin said in a rather conclusive manner that the present problem of fuels is the development of fuels capable of withstanding sudden increase in output, and he proposed concerted effort at removing cladding inner surface defects, all out effort to enable maximum margin in temperature at which fuel center melting takes place, and the removal of creep deformation of cladding due to external pressure, avoidance of fretting corrosion, and reduction of crud (grime) as means of improving fuel behavior. At the present time, the Soviets generate 8 million KW from the nuclear power plants presently in operation, and they hope to be able to realize 4-6 percent per minute increase in output, but this is a rather unrealistic level at the present time. What was unexpected here was the conclusion they arrived at among the remedies proposed for improving fuel to enable adaptation to increased load such as the placement of ribs to the inner surface of the cladding and the double inner-outer layer deployment of pellets were disadvantageous economically speaking. This emphasis on the economics coming from the Soviets was extremely interesting.

This concluded the first day's sessions, and a party was held at the Tokai University Alumni Hall in Kasumigaseki Building.

A Soviet representative chaired the second day's sessions, and the fourth session was opened with myself presenting a description of Japanese history of fuel design starting off with the JPDR-II, and including some discussion of ATR. The first Soviet paper was presented by V.S. Belbatsef under the title "Some Problem Areas in Production of Ceramic Fuel for Light Water Cooled Power Reactors." He discussed Soviet experiences along this line, compared the preparation of uranium dioxide between the dry and wet methods, and explained the differences in particulate shapes by the two methods on the blackboard. He said that polishing pellets resulted in powder adhering to the surface which became the medium for absorbing moisture, and he stated that moisture was undesirable in that it enhanced the chemical activity of fluorine. They are considering the use of vibration backing for fabricating fast breeder reactor fuel, but the density is not high enough for a thermal neutron reactor. High density uranium dioxide of good packing property is so hard that it forms scratches on the inside surfaces of cladding tubes and is therefore unsuitable. While they have produced some test fabricated fuel, none has proved to be practical.

Questions Concentrated on Japanese Technology--Cladding Tubes

The fifth session held on the afternoon of the second day was titled "Fuel Cladding Tubes," and the first speaker on the Japanese side was Mr Yutaka Kondo from Sumitomo Metals who presented an outline of fuel cladding tube development in Japan. Since the light water reactor is a purely American technological introduction, it was not possible to broach this subject as

purely a Japanese development. On the other hand, a completely Japanese development is a fuel cladding tube that ranks in quality with the best in the world, and this was the one paper from the six papers offered from the Japanese side that drew greatest attention. This was an unexpected contribution from the Japanese side. The Soviets thought likewise, and this paper was the impetus to their most intensive questioning.

The Soviet papers were led off by A. A. Mayorshin who discussed research on the effects of in-reactor irradiation on the dynamic properties of the zirconium alloy H1 (alloy with 1 percent niobium) that has been developed as cladding material by the Soviets. The H1 alloys of the past contained 1 percent niobium with oxygen content of 800 ppm. This alloy together with 2.5 percent niobium alloy for pressure tube use and H1 alloy with oxygen content increased to 1300 ppm were the three materials used to fabricate 9.15 mm diameter and 0.65 mm wall thickness tubing. These tubes were irradiated, and their dynamic properties were compared. It was concluded from the results of creep rupture tests that the alloy with 1300 ppm oxygen exhibited particularly good creep rupture strength. It was said that this alloy is not only strong but did not suffer creep down under PWR conditions even without internal pressurization. When the question came up from the Japanese side, "such being the case, do you intend to change to use this material from now on," the answer was that all the material actually used is the 800 ppm material, and there is as yet no plan to use this 1300 ppm oxygen material even in the VVER 1000 which is the PWR that will be constructed. When Kondo said that the Japanese have been aware of the good creep property of this high oxygen material and have been pointing toward raising the oxygen content of zircaloy to 1200-1300 ppm, Gorobunin said "my country is certainly conservative compared to your country" and everyone enjoyed a hearty laugh. It was said that there was a feeling that zircaloy is inferior to H1, and when asked why, and the answer was that the ductility of H1 after irradiation was superior such that H1 cladding material did not suffer stress crack damage.

The subject of the sixth and final session was "Post Irradiation Test Facilities and Test Results," and the Japanese speakers were led off by Yasuo Hirose of NFD who described the test facilities for examining materials after actual irradiation that are located at NFD and the Tokai Laboratory of the Japan Atomic Power Research Institute. This was followed by a Soviet talk based on out of reactor tests on pressure tube type light water reactor fuel elements which was given by P.A. Pratonov head of the Radioactive Materials Research Department of the Kruschev Atomic Power Research Laboratory, and he was the only one of this five-man group to deliver his speech in English.

NFD was the subject of Soviet inspection visits along with the Sumitomo Zircaloy Plant, and the explanations were very specific. Platonov described P-E (post irradiation examination) of WWER-440 fuel. He stated that the electron beam method was used to weld the end plugs of the Soviet fuel rods, and the hydrogen absorption that is a characteristic feature of niobium alloys was claimed to be less than that of zircaloy in which hydrogen

absorption was 60-80 ppm at 40,000 MWD/T burnup and 100 ppm at 83,000 MWD/T burnup. The 83,000 degree of burnup mentioned here is very unusual, and after operating without damage to this stage, another 10,000 extra burnup resulted in the fuel elements completely losing their integrity.

Since this talk was given in English, there was no need for an interpreter as a result of which there was extra time left for discussion, so the discussion was opened to cover the entire seminar. A question was advanced on the handling of LOCA (loss of coolant accident) in which the problem of fuel cladding maximum strength (PCT) being sufficient of 525 M/cm liner output density whereupon the answer was that the values could be confined within the limiting values according to calculations by a Soviet formula. On the other hand, the PCT limiting values are presently being studied. Based on data showing no problem if temperature is below 1400 degrees, there are the 1300 degree and 1200 degree proposals with the latter being considered more effective at the present time.

Summarizing the entire seminar, many facets of the contents of Soviet light water reactor technology were made fairly clear for the first time, and it was a profitable seminar where we were concerned. As mentioned by leader Gorobunin in his final address, it was a seminar of many rewards to the Soviets as the result of their contact with the advanced nuclear power technology of Japan.

Attendees

Soviet Side

I. S. Gorobunin (chief of the Nuclear Fuel Research Department, All Union Inorganic Materials Laboratory)

E.I. Yakshin (chief of Nuclear Reactor Irradiation Laboratory, Nuclear Reactor Materials Laboratory)

V.S. Velbatsev (head of Ceramic Fuel Technology Department, All Union Inorganic Materials Laboratory)

A.A. Mayorshin (principal investigator, Fuel Cladding Tube Material Development Department, Nuclear Reactor Science Laboratory)

P.A. Platonov (chief of Radioactive Materials Research Department, Kruschev Atomic Power Laboratory)

Japanese Side

Seishi Hisake (assistant chief, Technology Department, Japan Atomic Power Company)

Noboru Morioka (assistant chief, Nuclear Fuel Department, Atomic Power Laboratory, Kwansai Electric)

Hironori Ono (overall coordinator, Nuclear Power Development Laboratory, Central Research Laboratory of the Electric Power Industry)

Yoshinori Mishima (professor, University of Tokyo)

Yutakan Kondo (chief of Tokyo Technology Department, Sumitomo Metal Industries)

Yasuo Hirose (chief of Research Department, Japan Nuclear Fuel Development)

Technological Advisor

Yasukuni Shinohara (chief of the Atomic Reactor Control Laboratory, Nuclear Engineering Department, Tokai Laboratory, Japan Atomic Power Research Institute)

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FUELS AND RELATED EQUIPMENT

CONSTRUCTION OF URENGOY-NOVOPSKOV GAS PIPELINE CONTINUES

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 2-4

[Article by N. V. Petlichenko, head of Administration of Capital Construction: "Gas Pipeline Urengoy-Novopskov--Key Construction Site of the Year"]

[Text] Gas-transport system Urengoy-Novopskov: gas pipelines Komsomol'skoye-Surgut-Chelyabinsk (first phase), Urengoy-Chelyabinsk (second phase), and Chelyabinsk-Petrovsk 1,420 mm in diameter, Petrovsk-Novopskov 1,220 mm in diameter; 47 compressor stations.

The gas pipeline route crosses 20 water obstacles of which the following are especially difficult: the rivers Ob', Irtysh, Volga, Oka, Ufa, Belaya, Don, and the Kuybyshevskoye reservoir.

The gas pipeline Komsomol'skoye-Surgut-Chelyabinsk (1,500 km): 13 compressor stations a large number of which are equipped with domestic aggregates GTK-10-4 and STD-12500.

Apparatus of air cooling are used to cool the gas. The gas is compressed by superchargers 370-18-1 and 370-18-2 connected according to the parallel-serial circuit. Gas purification is in cyclone dust catchers with output of 20 million m^3/day.

The GTK-10-4 aggregates are assembled in two wings of the shop (in one wing 5 and in another--3 aggregates), while the STD-12500--in one building. The building of the shop is made up of a metal housing covered with aluminum wall panels.

Imported aggregates are installed in individual sheltered buildings. Gas compression is implemented in a two-stage supercharger with drive from a gas turbine. Auxiliary structures of compressor stations have been planned in folding complete buildings and block-boxes.

The gas pipeline Urengoy-Chelyabinsk (1,700 km): 17 compressor stations equipped with domestic aggregates GTK-10-4 STD-12500 and GPU-10.

Gas pipeline Chelyabinsk-Petrovsk (1,200 km): 11 compressor stations and gas pumping aggregates GTK-10-4 and GPU-10.

Gas pipeline Petrovsk-Novopskov (609 km): 5 compressor stations equipped with gas pumping aggregates GPA-Ts-6.3 with aeronautical drive.

The constant increase in gas extraction in the eastern regions of the country to provide the main gas-consuming regions of the European sector of the USSR and Urals requires full realization of the program of capital construction to put new facilities for extraction and transport of Tyumen' gas into operation in the established periods.

In 1979 it is necessary to build over 9,000 km of trunk gas pipeline, 72 compressor stations, and 11 units of complex gas preparation, including 2 UKPG [units of complex gas preparation] at the Urengoy field. The main volume of construction is for the gas pipeline Urengoy-Chelyabinsk (second branch), Nizhnyaya Tura-Perm'-Kazan'-Gor'kiy, and Gryazovets-Leningrad, on which half of the planned compressor stations are being built.

The key construction site of this year is the system of gas pipeline Urengoy-Chelyabinsk-Petrovsk-Novopskov extending about 4,000 km. It is one of the main objects that guarantees an increase in the volume of gas supply to the national economy in the current five-year plan and the future. In 1980 it remained to bring the system of gas pipelines to the planned output.

In developing the draft system of gas pipelines Urengoy-Chelyabinsk-Petrovsk-Novopskov the institutes YuzhNIIgiprogaz [Southern Scientific Research Institute for State Planning of Gas Pipeline], VNIPItransgaz [All-union Scientific Research and Planning Institute of Gas Transport], Soyuzgazproyekt, and Giprogaztsentr [State Center for Planning of Gas Pipelines] used new progressive technical solutions to guarantee an improvement in the technical and economic indices of gas transport, and increase the effectiveness and reliability of operating the gas transport systems.

For the first time in the practice of planning YuzhNIIgiprogaz conducted complex optimizing of the technological parameters of the gas pipeline, which made it possible to determine the most profitable output, number and arrangement of compressor stations, and the hydraulic and temperature pattern of gas transport.

There was a significant increase in the reliability of the linear section of the gas pipeline thanks to the introduction of new methods of calculation (using computers) of the structural assembly for longitudinal stability in the entire

range of working temperatures proposed by the VNIIST [All-union Scientific Research Institute for the Construction of Trunk Pipelines].

More complete designs of weights, as well as screw and pile-supported anchors with hinged blades have been used to ballast the gas pipeline.

On the gas pipeline an equal-flow-passage cut-off fitting with pneumatic and hydraulic drive is being installed, linked to the system of linear remote control. The possibility of periodic cleaning of the gas pipeline cavity in the process of operation without cutting off the gas supply is provided with the help of cleaning devices by starting and receiving them in special assemblies.

In order to clean the gas before the superchargers on the compressor station platforms cyclone dust catchers of increased output (20 million m^3/day) are installed, which reduced the metal-consumption of the compressor stations a great deal.

Since the gas pipeline passes in climate zones with low average annual temperatures, in order to reduce the temperature expansions of the linear sections of the gas pipelines, to increase the throughput and decrease the specific consumption of gas for compressing a unit of apparatus for cooling gas at each compressor station has been provided for.

The unitized delivery of gas-pumping aggregates and the placement of auxiliary services in the block-set devices of plant manufacture have made it possible to sharply reduce the periods for construction of compressor stations.

In the construction of the compressor stations in the system of gas pipelines Chelyabinsk-Petrovsk-Novopskov for the placement of auxiliary services and structures for the first time module items were used instead of individually standing block-boxes. Thanks to this the dimensions of the compressor station platforms and the extent of the pipelines have been significantly reduced, and the working conditions of the service personnel have been improved.

By the joint efforts of institutes, associations of the branch and related ministries and departments new progressive technical solutions are being implemented.

Construction of a gas pipeline Urengoy-Chelyabinsk (second phase) was started in 1978, and by 1 May 1979 the construction-assembly work on the flooded and swampy section of the gas pipeline was completed.

In the construction of the linear section of the gas pipeline the brigades of welders, insulators and excavators were united into one stream, which sharply increased the labor output. The introduction of progressive technology (electric arc welding of pipelines in a protective medium of inert gases, electrocontact welding of large diameter pipes with the semi-automatic aggregate "Sever-1") made it possible to guarantee high quality work.

When there are a large number of extensive and deep swamps on the route construction of the gas pipeline is mainly carried out in winter, since in the summer it is practically impossible to supply pipes and cut-off fittings.

Taking this into consideration the construction organization of the Minneftegazstroy [Ministry of Construction of Petroleum and Gas Industry Enterprises] provided the necessary number of complex brigades and finished the construction-assembly work on the swampy section of the second branch of the gas pipeline Urengoy-Chelyabinsk in the winter period in 4 months. On this section of the route over 95,000 weights were installed and over 130,000 anchors.

Domestic practice has not known such rates of construction of gas pipelines 1,420 mm in diameter on working pressure of 75 kg-f/cm^2. The construction is supervised by a staff including highly qualified specialists of the Mingazprom [Ministry of the Gas Industry] and the Minneftegazstroy.

Taking into consideration the exceptional importance of timely putting into operation of a system of trunk gas pipelines Urengoy-Chelyabinsk-Novopskov for accelerated development of gas extraction in West Siberia and its supply to the center of the country especial attention should be given to the maximum concentration of material and labor resources at the starting objects in order to significantly reduce the periods of construction, and guarantee the simultaneous putting into operation the linear section and the necessary number of compressor stations.

Our task is to mobilize all the production potential of the gas industry, all the reserves and potentialities for the successful fulfillment of the program of capital construction.

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PLANNING OF COMPRESSOR STATIONS WILL REDUCE CONSTRUCTION LABOR

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 5-7.

[Article by V. N. Sollogub, head of department of Administration of Capital Construction: "Ways to Increase Efficiency of Creating Compressor Stations"]

> [Text] For the successful fulfillment of the intensive assignments to put into operation the necessary number of compressor stations it is necessary to significantly reduce the labor intensity of their construction and this means to perfect the planned solutions of compressor stations.

In the last 5 years the annual putting into operation of compressor stations has doubled. The main conditions of such an intensive growth in the facilities in gas transport consist of the following.

The number of workers in construction was increased as a result of developing the construction base of the Minneftegazstroy [Ministry of Construction of Petroleum and Gas Industry Enterprises] after the isolation of this ministry from the Mingazprom [Ministry of the Gas Industry].

Labor productivity of the workers was improved by means of perfecting mechanization, energy supply, specialization and others.

The technical solutions of the compressor stations were perfected, introducing more ideal equipment, module designs and block-set devices.

During the years of the 10th Five-Year Plan in accordance with the program of technical re-equipping of the branch at the compressor stations there was broad introduction of new gas-pumping aggregates GPA-Ts-6.3 of the aviation type, electric drive block basementless aggregates STD-4000-2z, and introduction of aggregates GPU-10 of the naval type was started. The volume of use of block-complete devices is over 1,000 units per year.

The rates of growth of the gas industry in the 11th Five-Year Plan will require a further increase in labor intensity and reduction in the periods of construction of compressor stations with the provision of high reliability of their operation. Currently about one-fourth of the total number of compressor stations are still being built with surpassing of the standard periods.

The demographic situation that has formed in the country predetermines the involvement in construction of limited additional labor resources. Practice demonstrates that the growth in labor productivity in construction of ground objects of the gas industry, if one does not take into consideration such subjective reasons as inclusion in the volume of construction-assembly work of block-complete devices of plant manufacture and others, cannot continually increase and there are no grounds to expect its sharp rise.

Thus the calculations demonstrate that in order to fulfill the assignments for putting into operation the necessary number of compressor stations, the labor intensity of their construction with regard for an increase in quality and completeness of work needs to be reduced by double. This requires primarily perfection in the planning solution of the compressor stations.

There are also other ways, for example, organization of two-and three-shift work in construction. However these organizational forms are used very rarely.

As already noted the key factor that determines the perfection in the technical solution of the compressor stations is the type of gas-pumping aggregates.

For the gas industry a top-priority task of the present is testing and introduction of aggregates with output of 16,000 and 25,000 kw, which as compared to the use of machines with output of 10,000 kw will yield correspondingly a decrease in the volume of construction work by 25-40%.

A considerable decrease in the volume of assembly work can also be provided by the use of a full-pressure supercharger developed by the Minenergomash [Ministry of Power Machine Building]. Unfortunately, the introduction of this equipment is being delayed due to the lag in construction work at the test stand implemented by the trust "Lengazspetsstroy."

Specific lag that has formed with the introduction of new gas-pumping aggregates results in the fact that the base machine for the compressor station still remain the GTK-aggregate that predetermines the labor intensity of construction of the compressor shop on the order of 75,000-80,000 man-days. Consequently, especial attention should be focused on perfecting solutions to create auxiliary structures of compressor stations, pipelines and work on a zero cycle.

Analysis of the estimated cost of the number of compressor stations demonstrates that the specific weight in the total cost is:

--construction of auxiliary production and administrative-economic buildings--8-10%;
--laying of pipelines--12-15%;
--work of zero cycle--15-20%.

Perfection in the technical solutions of compressor stations must be based on the available reliability of the equipment and the need to create normal working conditions for the service personnel. A decrease in the volume of space and

simplification in the design solutions are possible only as the level of automation and reliability of equipment increases.

In 1978 the special design office of the Minneftegazstroy was the initiator for the use at compressor stations of the gas pipeline Chelyabinsk-Tsentr of new solutions to create auxiliary structures and pipelines.

The second page of the book cover shows a scheme for the general plan of a compressor station with aggregates GPA-Ts-6.3 [photo not reproduced]. For the arrangement of auxiliary services module items of design of the experimental design office of the Minneftegazstroy were used that are capable of being joined on the lateral and end sides.

Sections of folding complete buildings (SKZ) are being used in the service-operational and repair blocks in addition to module items. Production subdivisions whose equipment requires increased height are placed in the SKZ sections. The SKZ sections are installed on ground level (figure), while the module items--at the 1.8 meter mark from ground level in order to place underneath them the technical cellar and to lay pipelines [photo not reproduced].

The pipelines emerge from the block-boxes through the foundation of the boxes to the technical cellar and are laid in them, which significantly improves the conditions for their maintenance, as well as the architectural appearance of the block. On the platform the main portion of the pipelines are laid above ground on scaffolds.

The use instead of individual standing block-boxes for the placement of auxiliary spaces employed previously of assembled module items has both positive and negative aspects. The main advantage of this arrangement should become an improvement in the operating conditions as a consequence of the interlocking of spaces and decrease in heat losses due to the heated technical cellar. In addition, the length of pipelines is reduced and the area of the general plan of compressor station is decreased by 0.8-1.0 ha. At the same time the volume of operations fulfilled on the platform for assembly of module items and SKZ, interconnection of pipelines and so forth increases; the level of specialization of structures is reduced.

According to the data of the special planning and design office of the Minneftegazstroy the use of these solutions must result in a decrease in the total labor intensity of compressor station construction by 4-5%, the estimated cost of construction by 7-8%, and should decrease roughly by 2 months the period of construction. The indicated basic solutions were recommended for introduction by a special jury of the USSR Gosstroy.

In the current year a number of compressor stations are being built in the gas pipeline Chelyabinsk-Tsentr according to the plans of the institutes "Giprogaztsentr" and VNIPItransgaz [All-union Scientific Research and

Planning Institute of Gas Transport]. As the construction is being implemented it will be possible to make a real evaluation of the technical and economic aspects of the solutions.

Recently other industrial projects for construction of compressor stations have become widespread. For example, the piling-supported foundations under buildings and equipment, the separation of cycles for erecting surface and underground sections of structures, sectional designs for covering passages, platforms and floors.

Of greatest importance is an improvement in the organizational process of the block-complete method of construction. Among the many questions of organization the completeness of items supply is essentially in the first place. It is no accident that recently the term (and possibly, rightfully) complete-block construction has begun to appear.

With the total positive results of the block-complete method of construction noted above there are currently in the employed solution also significant shortcomings--an increase by 10-15% of the estimated cost and metal-consumption of compressor stations. With the available discrepancies in organization essentially there is no observation of the significant decrease in the periods of construction, only the labor intensity of work at the platform is reduced, i.e., the effect is realized by the construction organization and not the customer.

From this follows the need to perfect the system of specific technical and economic evaluations of block-complete devices and method as a whole based on an analysis of the consumer (useful) effects.

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CSO: 1822

FUELS AND RELATED EQUIPMENT

VNIPIGAZDOBYCHA DEVELOPS PLANS FOR CONSTRUCTION OF URENGOY FIELD

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 7-8

[Article by A. V. Buyerakov, director of VNIPIgazdobycha: "Industrial Principle as the Basis for Construction"]

[Text] The accelerated development of the gas industry, one of the youngest branches of the national economy, is based on the constant perfection in planning. Provision of the most important construction sites of the branch with high-quality and opportunely issued plans is an indisputable condition of the operation of the collective of VNIPIgazdobycha [All-union Scientific Research and Planning Institute of Gas Extraction].

Especial attention is given to the construction sites of West Siberia, and the creation in the Tyumenskaya oblast of a powerful gas-extracting complex.

VNIPIgazdobycha has been involved with questions of developing the north and west Siberia for already 15 years. In this time the active fields of Igrimskoye, Punginskoye, Pokhromskoye, and Soleninskoye in Tyumenskaya oblast, Vuktyl'skoye in Komi ASSR, Mastakhskoye in Yakutiya, and Messoyakhskoye in Krasnoyarskiy kray have been built and put into operation.

The northernmost gas pipeline in our country has been built--Messoyakha-Noril'sk.

The presence of large supplies of gas in newly discovered fields in the north of the Tyumenskaya oblast shifted the center of gas extraction in the central regions of the European sector of the country to Siberia, and required a basically new approach in development of the fields.

In supporting the remarkable initiative of the Moscovites "orders of Siberia and the Far East--ahead of schedule, with excellent quality," we studied in detail the questions of accelerating planning of gas targets of Siberia, in the first place the Urengoy field.

In the constellation of Siberian fields Urengoy occupies a prominent place, stretching along the territory of the Yamalo-Nenetskiy autonomous okrug, measuring dozens of kilometers in length and width. Urengoy is "a hard nut." It is located considerably to the north of inhabited areas. Therefore the problem of developing Urengoy is a complex one: installation, laying of gas pipelines Urengoy-Surgut-Chelyabinsk-Petrovsk-Novo-Pskov and Urengoy-Nadym to supply blue gold to the center of the country, and creation simultaneously with this of the modern city of Urengoy, an airport, railroad and automobile roads.

We started solving the problem of Urengoy in 1972. Thirteen planning and scientific research organizations participated in the development of a technical plan "Urengoy-30" (institutes Fundamentproyekt [State Institute for the Planning of Foundations and Substructures], Lengiprotrans [Leningrad State Planning and Surveying Institute of the State Industrial Committee for Transportation Construction], Lenaeroproyekt, TyumenNIIgiprogaz, TsKBN [Central Design Office of Oil], Tyumen' Medical Institute and others).

The development of the technical plan was carried out using materials of frozen ground-geological surveys of the construction region made by the institute VSEGINGEO, and a medical-sanitary survey of the region of the Urengoy gas-condensate field.

The development of the technical plan "Urengoy-30" was preceded by an investigation of the experience of planning and laying pipelines in the gas field Medvezh'ye and the oil field Samotlor.

The basis for planning is principles of the maximum centralization of targets for preparation of gas and condensate transport, and automation of all the technological processes.

The main task of laying the pipelines in the Urengoy field is selection of the optimal schemes of collection and preparation of the gas for transport.

It was required to find a solution that was suitable for Senoman, as well as for the underlying beds, i.e., a unified single scheme of laying pipelines. The constant creative search, accumulated experience, and analysis of the work of active fields made it possible to employ at Urengoy a number of innovations.

Thus for the first time in the practice of Mingazprom [Ministry of the Gas Industry] multiple drilling of wells was used and the standard traditional radial collection was replaced by a collector scheme. This made it possible to reduce roughly 5-fold the length of the field pipelines. The first UKPG [unit of complex gas preparation] at Urengoy are almost the same as at Medvezh'ye, where block equipment was used with output of 3 billion m^3 of gas per year. In the plan "Urengoy-30" increased pressure was included, regeneration of diethylene glycol was improved, and a number of pumps were added.

Thanks to this the capacity of the UKPG rose from 7 to 10 billion m^3 of gas per year, and the output was increased by 30%.

In the further work for planning the UKPG-4-5-6 ("Urengoy-60") the planning was improved, for the first time 5-million technological branches were used or developed by the TsKBN. This made it possible to increase the capacity of each UKPG to 15 billion m^3.

The regeneration of glycol is also being changed in principle. Whereas at the first four units steam regeneration is used, at the fifth unit flame regeneration of glycol will already be introduced with the use of new domestic equipment developed by the Minkhimmash [Ministry of Chemical and Petroleum Machine Building].

At Urengoy for the first time gas-air heating elements will be tested to heat the production buildings, making it possible to exclude construction of boiler houses and other auxiliary equipment, which will improve operation of the facilities and will make construction less expensive.

Construction of Urengoy is based on the industrial principle. Practically all the auxiliary targets are made in block-boxes. All the structures--from the most complicated technological units to everyday rooms and storehouses are pre-assembled.

For the first time in the practice of Mingasprom a gas-turbine powerplant in the block-complete design with capacity of 72 MW has been used to supply energy to the field.

Due to the unification of projects in the general plans the density of development has been brought to 35-40 instead of 27%.

At Urengoy for the first time in our country a basically new method of road construction has been used. For example, at UKPG-2 an approach road has been planned with glass concrete pavement. This will make it possible to significantly reduce outlays, and most important--to accelerate putting into operation roads which can already be used within 17-18 hours after laying the pavement.

As a result of the realization of the adopted solutions UKPG-1 and UKPG-2 were put into operation ahead of schedule--the country received from the depths of the field the first 13 billion m^3 of blue fuel. This year the output of Urengoy will reach 30 billion m^3 of gas per year. Thus the UKPG of the Urengoy field were put into operation two times faster than the UKPG at the field Medvezh'ye.

The complex use of the deposits of Urengoy, in particular, the Valanzhin bed, raised the question of reprocessing condensate.

As a result of the joint work of the institutes VNIIgaz [All-union Scientific Research Institute of Natural Gas] and VNIPIgazdobycha a draft was made of an experimental unit to obtain diesel fuel, whose construction is approaching completion at the UKPG-1. This is the first step towards a complex solution of the problem of reprocessing condensate and the comprehensive use of raw material.

The experimental unit will be the basis for planning and construction of the condensate-reprocessing plant.

At Urengoy we also plan to test new equipment--turbine-expansion and aggregates which will make it possible in principle to alter the scheme of gas preparation. Soyuzturbogaz has already shipped 12 turbine-expanders that are planned for use at the stations of gas cooling.

Soon a railroad from Surgut should reach Urengoy, which will make it possible to conduct intensive residential construction. It is planned to create additional energy plants which will be included in the unified system of energy supply for the region.

The Urengoy field in the current five-year plan will yield more than half of the increase in gas extraction for the country. Currently the institute is carrying out work to create documents to increase gas extraction at Urengoy to 60 billion m^3 of gas per year, as well as for bringing extraction in the future to 175 billion m^3 per year. It is planned at UKPG-8 and 10 to employ 10-million production lines whose experimental model will be tested at UKPG-4.

One of the features of development of the north is the leading construction of residences. Severe nature requires the creation of comfortable conditions. The future city of gas workers is Urengoy; by commission of Gosgrazhdanstroy we are involved in its planning and it must meet these requirements.

At the same time we are working on the creation of a draft for the subsidiary services of the city, in which will be placed: pig-feeding farm, hangar type greenhouse and other agricultural objects.

Development of Urengoy is a new page in the labor chronicle of the country. The collective of our institute is working with enormous inspiration on solving the tasks set by the 25th CPSU Congress to increase gas extraction. The labor of the planners has been highly evaluated by the leadership of Mingazprom. For already 4 years in a row the collective of VNIPIgazdobycha in the all-union socialist competition has been awarded the challenge red banner of the Mingazprom and the central committee of trade union of workers of the oil and gas industry.

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FUELS AND RELATED EQUIPMENT

YUZHNIIGIPROGAZ RESPONSIBLE FOR PLANNING URENGOY PIPELINE

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 9-10

[Article by V. D. Batozskiy, director of YuzhNIIgiprogaz: "Gas Pipeline Urengoy-Chelyabinsk: Experience in Planning"]

[Text] The collective of YuzhNIIgiprogaz has started planning a system of trunk gas pipelines Urengoy-Surgut-Chelyabinsk, having behind them great experience to create gas pipelines under complex natural and climate conditions. Before this it participated in construction of the gas pipelines Ust'-Vilyuy-Pokrovsk-Bestyakh in Yakutiya, two branches of the gas pipeline Medvezh'ye-Nadym, and four branches in the system Nadym-Punga in the northern Tyumenskaya oblast.

Nevertheless the task of planning the system Urengoy-Surgut-Chelyabinsk was exceptionally complicated.

The complexity of the natural and climate conditions along the route of the gas pipeline, the large diversity of factors affecting the formation of a technical and economic indices of gas transport governed the need for working out a large number of variants of technical solutions.

In principle it was impossible to fulfill this work under conditions of extremely condensed periods, by using the old technology of planning. Therefore the planners used a new method of analyzing the effectiveness of different variants of the planning solutions.

For the first time the main technological parameters of the system of gas pipelines--output, number of compressor stations and distance between them, hydraulic and temperature patterns of gas transport--were determined by the institute as a result of optimization calculations on a computer.

For this a technique and complex of programs of technological and technical-economic calculation developed by the institute of gas of the Ukrainian SSR Academy of Sciences and YuzhNIIgiprogaz were used.

Since YuzhNIIgiprogaz was designated the general planner of the gas pipeline Urengoy-Surgut-Chelyabinsk, its commitment included not only definition and substantiation of the technical and technological parameters of the entire system as a whole, but also coordination of activity of the subcontracting institutes of the ministry of the gas industry (VNIPRtransgaz [All-union Scientific Research and Planning Institute of Gas Transport], Soyuzgazproyekt and Giprospetsgaz [State Institute for the Planning of Special Structures in the Gas Industry]), operating on individual sections of the gas pipeline, and specialized planning institutes of other ministries and departments developing documents for individual objects. The latter included: trunk and delivery radio relay lines of communication, transitions over major water obstacles, approach railroads and sidings, objects of residential-communal purpose and fish protection, and so forth.

The route of the pipeline Urengoy-Surgut-Chelyabinsk crosses several physical-geographical zones that are characterized by different engineering and geological conditions for laying the gas pipeline. In the northern area of the route there are a large number of sections where permafrost rocks of massive-insular and insular spread have developed from slightly icy, slightly sagging to strongly icy, strongly sagging. On a very large distance the route of the gas pipeline passes over swamps and flooded soils. The complexity of the natural situation also governs the features of the entire cycle of operation for surveys and planning the gas pipeline.

The surveying work on the route of the gas pipeline and its structures Urengoy to Chelyabinsk was executed by the surveying subdivisions of the institutes of YuzhNIIgiprogaz, Soyuzgazproyekt and VNIPItransgaz with the involvement of special engineering geocryological studies specialists from the institutes of the USSR Gosstroy--PNIIS [Industrial and Scientific Research Institute for Engineering Surveys in Construction] and NIIOSP [Scientific Research Institute of Foundations and Underground Structures].

In the fulfillment of the surveys aerial methods were widely used in all types of survey work, helicopter and 4-wheel drive vehicles. The laboratory processing of the surveying information was carried out with the use of computer technology.

The high level of planning technical solutions for the gas pipeline was reached thanks to the use of a whole series of innovations.

For the first time progressive methods were used for calculating the linear section for longitudinal stability, the predicted flooding of the gas pipeline in the process of its construction and operation was considered, and more effective designs were provided for ballasting the gas pipeline.

At the compressor stations purification of the gas in dust-catchers of the cyclone type was provided for with output of 20 million m^3 per day and gas cooling in apparatus of air cooling up to a temperature exceeding by 10-15° C the temperature of the surrounding air.

All the compressor stations were equipped with gas-pumping aggregates of unit capacity 10,000-12,500 kw with gas-turbine or electric drive.

The conducted calculations for optimization and application of progressive technical solutions made it possible on the first branch of the gas pipeline alone to reduce the capital investments by 124 million R. The expected annual economic effect from operating the gas pipeline--79 million R.

The planners of the YuzhNIIgiprogaz are making a great contribution to the construction of the gas pipeline by implementing author's supervision.

Specialists of all profiles, relieving each other are constantly on the route, rapidly solving questions arising for the builders, which promotes a reduction in the periods for fulfillment of assembly operations and increases their quality.

The staff of construction based in Tyumen' is coordinating the work of the brigades of author's supervision of all planning institutes. In 3 years of the 10th Five-Year Plan the colleagues of the institute YuzhNIIgiprogaz have spent on author's supervision over the construction of the gas pipeline Urengoy-Surgut-Chelyabinsk over 7,000 man-days, whereby half of them were in 1978.

The putting into operation the gas pipeline Urengoy-Surgut-Chelyabinsk is the most important national economic task of the country, that requires a clearly organized and business-like cooperation of the builders, operators and planners.

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TYUMENGAZPROM RESPONSIBLE FOR GAS EXTRACTION AND TRANSPORT

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 10-11

[Article by E. G. Beglyarov, deputy head of VPO "Tyumengazprom": "Responsible Functions of the Customer"]

[Text] In 1980 it is necessary for the all-union industrial association "Tyumengazprom" to guarantee the extraction and transport of gas in a volume of 148.2 billion m^3, i.e., to increase it 34 billion m^3 as compared to 1979.

Almost the entire increase in extraction and transport of gas is provided from introducing new production capacities. Thus in 1979 it remains to utilize about 1.5 billion R of capital investments, and carry out construction-assembly work for almost 1 billion R.

The association "Tyumengazprom" acts as the customer for the construction of all objects being built by the general contract method. The main volume of work (up to 90%) is fulfilled by the organizations of Minneftegazstroy [Ministry of Construction of Petroleum and Gas Industry Enterprises].

By the joint efforts of the general contract organizations and services of the customer a large number of new industrial plants have been put into operation, which has made it possible for Tyumengazprom to occupy the first place in the branch for daily extraction of gas. The field Medvezh'ye has reached rated capacity, here 9 units of complex gas preparation have been built, and a city of gas extractors has arisen--Nadym.

Development of the Urengoy gas condensate field, the largest in the Tyumenskaya oblast has been started; here two units of complex gas preparation are already providing industrial gas, and UKPG-3 and UKPG-4 are being built. A new gas storehouse--Vyngapurovskoye field has been developed.

From 1975 to 1979 321 and 244 gas wells have been drilled and connected respectively, including 161 connected at the Medvezh'ye field, 47 at Urengoy and 36 wells at Vyngapurovskoye.

There have been 2,934 km of trunk gas pipelines put into operation, of them 2,420 km on the system of gas pipelines of the northern regions of the Tyumenskaya oblast--Urals with 27 compressor stations.

Practically in 1.5 years--from March 1977 through 15 May 1979 the large gas pipeline Vyngapurovskoye field-Chelyabinsk (first branch) was constructed extending 1,540 km, and in the current year construction is being completed of the gas pipeline Urengoy-Chelyabinsk (second branch) extending 1,748 km.

Two compressor stations have been put into operation, and work is continuing on 15 compressor stations. A gas pipeline has been built for transporting casing-head gas extending 950 km.

Urengoy Field. UKPG-2

A lot has been done by the association to improve organization of work of the services of the customer. The Surgut, Tyumen' and Vyngapurovskiy managements have been recreated for construction of gas pipelines with 12 departments.

The most complex in the entire system of construction is the timely provision of equipment to the targets. Due to the absence of roads the equipment can only be supplied to the majority of targets along winter roads, and in the summer--by aviation. For the purposes of centralizing control over all types of transport a transportation administration has been set up in the association "Tyumengazprom."

In the winter period of 1978/79 over 100,000 T of equipment was imported to the route of the gas pipeline Urengoy-Chelyabinsk, and to the sites of the compressor stations under construction. The timely importing of equipment to the route of the gas pipeline made it possible for the construction organizations to install the crane assembly and finish work on the linear section of the gas pipeline ahead of schedule.

By the joint efforts of the association, planning institutes of the Ministry of the Gas Industry, institute SibNIPIgazstroy [Siberian Scientific Research and Planning Institute of Gas Construction] and the association "Sibkomplektmontazh" the question was solved of manufacturing block-boxes of auxiliary structures for the compressor stations under construction for the gas pipeline Urengoy-Chelyabinsk at the plants of Sibkomplektmontazh and their delivery in assembled form to the site. This made it possible to reduce the periods of installation of structures.

Due to the seasonal nature of construction there is a very acute question of isolating equipment, especially heavy, by the supplier plants no less than a year before the start of work at the object. The importing of equipment is restrained also by the fact that the constructed railroad Tyumen'-Surgut does not cope with the increased freight flow, while the railroad sidings to the bases of the customer and the approach roads to the sites of the compressor stations and UKPG are being constructed with great lags.

Annually the plans of work for construction of automobile roads with hard pavement, power transmission lines, and radio relay communication lines are not fulfilled.

Due to the insufficient capacity of the construction organizations building of residences and social and cultural facilities for the gas workers is lagging.

The solution to these questions is the focus of attention of the leadership of the association. For the successful implementation of the construction program of the most important construction sites of the branch we must labor intensively. All the organizational and mass-political work of the party, trade union, komsomol organizations and economic leaders is directed towards this.

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FUELS AND RELATED EQUIPMENT

IMPORTANCE OF EQUIPMENT SUPPLY TO CONSTRUCTION SITES

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 12-13

[Article by E. G. Odintsova, head of administration for procurement of equipment: "On the Path to Creating an ASU for Complete Set Formation of Construction Sites"]

[Text] Improvement in the effective use of resources of equipment selected for the branch and reduction in its warehouse supplies are the decisive conditions for forced construction of new objects of the gas industry.

In the last 3 years of the 10th Five-Year Plan the Ministry of the Gas Industry has created and put into operation over 14,000 km of gas pipelines, 113 compressor stations, 49 units of complex gas preparation equipped with modern equipment and automated control systems.

The modern complete set formation of construction sites with equipment and cable products plays a great role in guaranteeing the putting into operation of the industrial plants.

In the Ministry of the Gas Industry a well-proportioned branch system of complete set formation of the targets to be built has formed which makes it possible to rapidly maneuver material resources and concentrate them on targets with the greatest construction readiness, whose putting into operation provides the greatest increase in extraction and transport of gas.

The ministry is focusing a lot of attention on perfecting the order of complete set formation of the construction sites with equipment. Thus, for example, the administration for procurement of equipment jointly with the electrical engineering section of the institute Giprospetsgaz [State Institute for the Planning of Special Structures in the Gas Industry] and the Angar electrical-mechanical plant have solved the question of unifying the power panels (ShchSU) employed in the gas industry, and their unified series have been developed and put into production. Jointly with the institute Giprospetsgaz and the all-union scientific production association "Soyuzgazavtomatika" a number of unified electrical items have been developed for series production that are not allocated by the USSR Gossnab (blocks of set clamps, illuminating panels and distributing assemblies). A unified series is being developed for panels

of direct current produced by the Tashkent electrical engineering plant. The use of unified panels in the plans made it possible to better maneuver the available resources.

For a further improvement in the complete set formation of the objects under construction it is necessary to formulate and to approve unified model solutions for compressor stations depending on the type of gas pumping aggregates used in them; to develop and introduce a modified specification which will expand the possibility of using equipment for construction sites. For the purposes of improving the responsibility of the planning organizations for the correctness and timeliness of the orders of equipment, and accelerated solutions to the questions of replacement in necessary cases of some types and modifications of equipment by others it is necessary to establish an order for ordering equipment in the set-forming organizations for equipment by the planning institutes jointly with the associations.

In addition to this it is necessary to conduct serious work for unification of the panels for control and measuring instruments and automation equipment and control systems; to accelerate the completion of unification of block-boxes for their use in the planning solutions.

The increased volumes of work for development of gas fields of the northern regions of the country elicit an acute need for the urgent review of standards of supplies of equipment in order to provide its seasonal imports to the construction sites in these regions. In the preparatory period of construction the general contractor must guarantee the erection of storehouses and specially equipped areas for the reception and storage of equipment, instruments and materials.

Especial attention should be paid to the most rapid creation of progressive standards of consumption of equipment, industrial pipeline fittings, and cable products.

The Ministry of Chemical and Petroleum Machine Building should force an increase in the capacities for production of the ball cranes, apparatus of gas air cooling for pressure 80 kg-f/cm^2, and also guarantee great reliability of operation of the industrial fittings, and apparatus in addition to reduction in their metal-consumption. The gas extracting targets of the branch have already been waiting for a long time for this ministry to manufacture and supply equipment of interblock pipelines for units of complex gas preparation.

Further perfection in the system of providing the construction sites with equipment must follow the path of complex automation of processes of set formation with broad use of economic and mathematical methods, i.e., on the path of creating automated subsystems of control over the material supply and set-formation of construction.

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NEW METHOD FOR LAYING UNDERWATER PIPES

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 13-14

[Article by A. A. Zeynalov, manager of trust "Azmorneftestroy," O. M. Mustafayev, chief production engineer of trust "Azmorneftestroy," and V. M. Kondrachuk, deputy head of all-union production association "Soyuzgazifikatsiya": "New Technology for Laying Underwater Pipeline"]

[Text] In the construction of the gas transport system for Urengoy to Novopskov it is necessary to surmount several dozens of water obstacles. One of the most complicated segments of the route is the passage through the Kuybyshev reservoir whose depth reaches 40 m and width 5 km.

The planning and construction of the passage was entrusted to the all-union production association "Kaspmorneftegazprom" of the Ministry of the Gas Industry. For the first time in our country the specialists of the institute "Gipromorneftegaz" and the trust "Azmorneftestroy" have developed new technology for laying underwater pipelines with the help of the pipelaying ship "Suleyman Vezirov."

According to the instructions of the pipelaying ship at depths of over 12 m the gas pipeline is laid with the help of a stinger (attachment for smooth descent of the pipeline). It serves as a support in the descent of the pipeline from the stern of the ship and regulates the curvature and tension in the length of pipe on the hanging section. Since it is impossible to transport the stinger (weight 315 T, draft 11.2 T) to the Kuybyshev reservoir a new technology for pipelaying has been adopted--laying pipe lengths with preliminary tension, equipped with discharging pontoons along the length of the entire route.

In laying pipelines at depths up to 20 m the pontoons are suspended every 20 m with tension in the length of pipe 20 T, and for depths over 20 m--every 13 m with tension in the length of pipe 40-45 T.

The passage is a 4-branch made of concretized pipes 720 x 16 mm in diameter of total length 22 km.

The underwater passage of the gas pipeline Chelyabinsk-Petrovsk through the Kuybyshev reservoir is being built in four stages: preparatory work, flattening of the reservoir bottom, laying of four branches of the pipeline, molding of all the branches of the pipeline and their loading.

The preparatory work (insulation, concretizing of pipes) is carried out on shore on a special unit of the plant of reinforced concrete items of the trust "Azmorneftstroy." Fairly high linkage of the pipe with concrete is achieved thanks to specially developed technology for applying the anticorrosion coating. The volume mass and thickness of the concrete are determined from the condition of stability of the gas pipeline on the bottom of the reservoir. The quality of the insulation and concrete coating predetermine the successful laying of the underground passage.

As a result of an analysis of the bottom relief a large quantity of depressions and projections were revealed in the construction section, which resulted in the need to flatten the bottom for a close fit of the pipeline to it. The bottom is leveled by the suction dredge "Tsyuryupinsk."

Under conditions of condensed periods of construction a decision was made to lay the gas pipeline in stages, which will guarantee the putting into operation of all four branches in one navigation.

According to the calendar schedule before the beginning of laying the pipeline the administration Chernomortekhflot of the trust "Chernomorgidrostroy" will prepare the route (2 km) on the right shore, after which "Suleyman Vezirov" will lay the first length of gas pipeline. For this the ship will be fixed by eight anchors and will begin welding pipes with the sealed end lowered along the inclined deck.

Nominal tension is given to the cable from the winch located on shore and attached to the end cap. As the pipes are welded the tension devices drive the pipeline towards the shore and the winch installed there pulls the pipe length under tension.

Onboard the ship every 8 m 2-section pontoons are suspended on the pipe length providing it with buoyancy. As the next pipe is welded on the pipe length is stretched towards the shore the length of one pipe. This process is repeated continuously until the beginning of the pipe length emerges on the shore.

On the shore the beginning of the pipe is securely anchored and the normal process of laying begins. Here the pontoons are separated and the pipe length is submerged. The ends of the pipe length are marked with a buoy.

The laying of the second pipe length begins from the left shore according to the previously described technology.

On the end of each pipe length five pontoons are left to provide joining. It is very important to carry out the layings such that the ends of the pipe lines are coaxial and have a supply of length that provides joining on the surface of the water.

The process of joining the ends of the pipe length is carried out as follows: after diver investigation of the position of the pipe length ends of the first branch on the bottom a special cage is suspended on the right side of the pipelaying ship. The ends of the first branch of the pipeline are lifted from the bottom by six crane beams, they are joined and again placed on the bottom of the reservoir. Thus, all four branches of the pipeline laid from the left shore are joined with the pipe lengths laid previously from the right shore.

After complete diver investigation of the laid branches of the pipeline the pipelines are hydraulically and pneumatically molded.

Thanks to the use of this basically new technology all operations for laying and molding the 4-branch underwater passage through the Kubyshev reservoir will be completed in October 1979.

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USSR AND WEST EUROPEAN GAS COMPENSATION AGREEMENTS

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 14-15

[Article by A. A. Shkuta, Moscow Financial Institute: "Compensation Agreements for the Construction Sites of the Gas Industry"]

[Text] The 1970's are the beginning of large-scale and long-term export of natural gas to West Europe. One of the new and most efficient forms of economic cooperation is compensation agreements which provide for the creation in the USSR of large industrial objects and complexes in different branches of the national economy with the involvement of foreign credits.

For the gas industry of the USSR based on compensation agreements the West European countries provide credits, on whose account steel pipes, fittings, equipment and materials are bought for developing the gas fields and building gas pipelines. Deliveries of natural gas will pay for the credits.

Such a form of cooperation on a mutually advantageous basis contributes to the solution of a number of urgent problems for the gas industry, in particular, in the area of capital construction, especially in the regions of West Siberia.

The final goal of the compensation agreements for us is accelerated rates of gas extraction in these regions to be developed and its supply to the center of the country.

The article published below acquaints the readers of the journal with the development of foreign economic relationships of the gas industry based on compensation agreements.

The mutually advantageous nature of transactions on a compensation base is determined by the following factors:

--the country-receiver of equipment has the possibility of enlisting additional resources, saving time and its own resources by the use of long-term credit which is paid by exporting a part of the product produced at the target constructed on the basis of compensation agreements. Here the actual target remains the property of the country that receives the equipment;

--the target created on a compensation basis satisfies the needs of the country for a specific product and expands the volume and nomenclature of its export;

--the long-term nature of compensation agreements provides for the country that receives the equipment a stable market for the sale of the corresponding product both in the period of payment of the credit given, and in the subsequent;

--the country that supplies the equipment receives the possibility of providing an additional load for the production plants and increasing the level of employment by realizing orders for the corresponding equipment, and also receives the possibility of stable satisfaction of demands for deficit types of raw material;

--the country that supplies the equipment, being interested in high quality of the purchased product, as a rule, strives to supply more advanced technology, at the same time promoting scientific and technical progress in the receiving country;

--in the nature of compensation agreements prerequisites are objectively present for subsequent expansion of economic cooperation with regard for mutual economic interests of both partners.

The gas industry is the forefather of the new form of foreign economic relationships of the USSR in the fuel industry. Back in 1968 in Vienna an agreement was signed for deliveries from the USSR to Austria of natural gas, and from Austria to the USSR of steel pipes, equipment and materials for developing gas fields and building a gas pipeline in the territory of the USSR.

The economic cooperation of the USSR with developed capital states in the area of the gas industry based on compensation agreements in the years of the Ninth and 10th Five-Year Plans was set up on a long-term and large-scale foundation.

In 1972 an agreement was concluded between the USSR and France for the sale of Soviet gas in exchange for the supply by French firms of equipment, pipes and materials for developing gas fields and building trunk gas pipelines. In 1974, meeting the desires of the French side the Soviet Union concluded with France an agreement on additional supplies. The major French firm "Gas de France" is a partner of the Soviet side.

In 1972 the USSR concluded an agreement with the FRG according to which large-diameter pipes and equipment were bought in the FRG for construction of a gas pipeline. The firm "Ruhrgas" is a partner of the Soviet side.

An agreement with the Italian company "Enl" was signed in 1969. It provides for delivery from the USSR to Italy for 20 years of about 110 billion m^3 of natural gas to compensate for large-diameter pipes, various equipment and materials. In 1975 an additional contract was signed for delivery in 1978-1980 of about 21 billion m^3 of natural gas.

In the order of fulfilling the compensation agreements in 1975 export of gas to West European countries reached 8 billion m^3 versus 1 billion m^3 in 1970. In the 10th Five-Year Plan supplies of natural gas to West Europe will increase.

Compensation agreements in the area of the gas industry have a specific nature. It consists of the fact that in buying on credit in countries of West Europe steel pipes, fittings and equipment the Soviet Union has the right to use them not on any certain target whose products should pay for these credits, but on the whole for the development of a network of trunk gas pipelines in the territory of the Soviet Union.

However the specific nature does not alter the compensation nature of agreements concluded by the USSR with developed capitalist countries in the area of gas industry. All the important signs of compensation agreements are inherent to these agreements:

presentation to the foreign banks of credits for financing the import to the USSR of machines, equipment, and materials for the development of the USSR gas industry;

payment of credits by means of proceeds from delivering products of the gas industry, for whose development equipment and materials were bought.

The compensation agreements touch not only questions of extraction and transport of gas, but also the problem of exploring the gas fields and developing them in regions of complex natural and climate conditions. An example of such cooperation is the plan for exploration and development of fields on the shelf of Sakhalin Island fulfilled in accordance with the general agreement on cooperation in the field of exploration, development of fields, extraction of gas and oil on the shelf of Sakhalin Island and deliveries of these goods to Japan. This agreement was concluded with the Japanese company "Sakhalin Sekiyu Kaykhatsukereku Kbusiki Kaysya" especially created for realization of the plan.

In accordance with the conditions of the agreement the company provided to the Soviet side commercial credit for a sum of 100 million dollars which is used mainly for paying the cost of renting machines and equipment, as well as the cost of materials and services necessary for conducting the geological

exploratory work in the first 5 years. Payment of credit will be implemented by supplies of oil and gas to Japan.

If it is necessary to continue geological exploratory work the Japanese side can present under analogous conditions another credit of 100 million dollars. If the geological exploratory work does not yield positive results, then the credit will not be compensated for by the Soviet side.

If profitable fields are found work to develop them will be carried out. According to the conditions of the agreement the Japanese side throught its banks must present to the USSR Bank for Foreign Trade credit for buying equipment, machines, and materials necessary to carry out the plan of field development. This credit will also be paid for by the Soviet Union through deliveries of gas and oil from newly discovered and equipped fields.

Questions of the effectiveness of compensation agreements in the area of the gas industry for the USSR national economy currently are being discussed by Soviet specialists. As yet one can only note that agreements on cooperation on a compensation bases between the USSR and capitalist countries, as a rule, are associated with the development of fields of the northern and eastern regions of the USSR that are distinguished by complex natural conditions and require the conducting of large volumes of geological exploratory work, and additional summary outlays are needed for this.

Complex natural and climate conditions govern the special requirements for machines, equipment and materials necessary to develop the fields, which also makes the project of development more expensive. At the same time the compensation agreements make it possible to enlist additional resources in the form of credits of the partner countries.

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FUELS AND RELATED EQUIPMENT

SUBSIDIARY FARMS TO FEED GAS WORKERS

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 p 16

[Article by S. A. Orudzhev, minister of the gas industry: "Fulfilling the Decisions of the July (1978) Plenum of the CPSU Central Committee"]

> [Text] "The industrial regions must have an agricultural base and provide themselves both with products of animal husbandry and vegetables. It is necessary to organize the matter such that, for example, fresh vegetables are in the stores year round. Is it really impossible to do this? It can and needs to be done, and not to import them say from the south or other oblasts. Such traffic is false, and if negligence is manifest here, then delays emerge in the trade networks, which produces legitimate discontent in the population...you must focus all attention on solving questions of providing the population with meat, milk, eggs, and vegetables of your own production." L. I. Brezhnev

To the leaders of the associations, enterprises and organizations, all party, trade union and komsomol organizations of the Ministry of the Gas Industry.

Comrades!

By the decree of the CPSU Central Committee and the USSR Council of Ministers of 4 December 1978 "on subsidiary rural farms of enterprises, organizations and institutions" the ministries and departments have been commissioned to set up subsidiary rural farms in enterprises, organizations and institutions, especially in remote areas where it is difficult to deliver agricultural products, as well as in newly developed regions with an insufficiently developed agriculture.

The ministry has done certain work to organize subsidiary rural farms in the structural subdivisions of the branch. In these farms in the 3 years of the current five-year plan the production of meat has risen almost 3-fold, milk 1.5-fold, and eggs more than 6-fold. In 1978 alone the sovkhozes and subsidiary farms of the branch supplied the workers of the gas industry over

7,000 centners of meat, 21,500 centners of milk, 5.6 million eggs and over 3,000 centners of vegetables.

The plans for production of animal husbandry products for 1979-1980 brought to the enterprises and organizations of the branch were developed with regard for the further increase in the rates of development of the rural subsidiary farms. In 2 years it is planned to increase on the whole for the branch the production of meat 4-fold, milk 2-fold and eggs 3.5-fold.

Unfortunately not all the enterprises and organizations of the branch guarantee the planned rates of development of subsidiary farms.

In the decree of the CPSU Central Committee and USSR Council of Ministers attention is paid to the need for intensifying the organizational work and use of all the available resources for increasing production of meat, milk, vegetables and other products in the subsidiary rural farms in order to improve the supply of food products to the workers and employees. Therefore it is important for the economic leaders of each collective jointly with the party, trade union and komsomol organizations to thoroughly analyze the state of development of rural subsidiary farms, and check their work against the rates of development of the branch and especially the leading enterprises.

In solving this important state task it is necessary at each compressor station, at each field, and plant to create complex subsidiary farms that produce agricultural products to completely meet the needs of the population for meat, milk and vegetables. In parallel with this each association must have a multiple-branch sovkhoz with highly mechanized animal husbandry farms, reliable feed base and qualified specialists. These large farms must be the basis for development of all the branch subsidiary farms, the reference points in solving technical, livestock, agronomical and other problems.

The leaders of the association, enterprises and organizations of the Ministry of the Gas Industry are obligated jointly with the social organizations to apply all their efforts towards the practical implementation of solutions of the party and government.

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WAYS TO INCREASE FOOD SUPPLY FOR GAS WORKERS

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 17-18

[Article by S. S. Kashirov, deputy minister of the gas industry: "On the Path Towards Development of Subsidiary Farms of the Branch"]

[Text] In the Ministry of the Gas Industry extensive purposeful work is underway to realize the decisions of the party and government in the area of developing subsidiary farms.

After the July (1978) Plenum of the CPSU Central Committee, and the decree of the CPSU Central Committee and the USSR Council of Ministers "on subsidiary rural farms of enterprises, organizations and institutions" the ministry jointly with the associations and enterprises of the branch developed and approved by the board of the Ministry of the Gas Industry measures for the creation and development of new sovkhozes, and subsidiary farms. The measures were directed, in particular, towards the further growth in livestock, poultry, meat production, and development of greenhouses. They stipulate the use of available reserves for creating a feed base by means of development of new land tracts and intensifying work for collection of food wastes.

In 2 years (1979-1980) it is planned to bring the stock of pigs to 38,000, sheep to 10,000, and to increase the number of poultry to 370,000, and expand the area of greenhouses to 150,000 m^2. This will make it possible to sharply increase the production of meat and other animal husbandry products. In 1980 it is planned to bring meat production to 22,000 centners, milk to 42,000 centners, and eggs to 19 million.

These plans are currently being widely realized. The subsidiary farm in the URS [administration of workers supply] of the association "Tyumengazprom" is developing especially rapidly. Already in 1979 2,500 centners of meat, 2 million eggs, 10,000 centners of milk, and 290 tons of vegetables will be obtained, and in 1980 the production of meat will be brought to 13,000 centners. Here positive experience has been accumulated for intensive feeding of animals in the swine breeding farms. Thus, the operator of the Beloyarsk pig farm Ye. V. Stepina achieved an average daily gain in weight per one head of 550 g. This is a very good result and her experience should be universally spread.

The development of the subsidiary farms in the URS of Orenburggazprom, Komigazprom and Uzbekgazprom is following an ascending line.

By the beginning of the current year the Ministry of the Gas Industry had four sovkhozes, two subsidiary farms, 23 swine feeding farms and active greenhouses of total area 40,000 m^2. These farms contained 2,670 head of cattle, over 15,000 head of pigs, 1,880 head of sheep and over 200,000 poultry.

The production of agricultural products during the elapsed period of the 10th Five-Year Plan is characterized by the following data:

	1976	1977	1978
Meat, centners	1,545	2,513	7,144
Milk, centners	15,571	18,804	21,470
Eggs, thousands	890	1,904	5,660
Vegetables, centners	-	2,990	3,165

A lot of resources are allocated for the development of branch agriculture of the Ministry of the Gas Industry. In 1978 alone the capital investments were 8.2 million R. Here pig sties for 11,650 head were introduced, cow barns for 600 head, poultry plants for 50,000 laying hens and a number of other objects. Currently greenhouses in area of 6,000 m^2 have been built in addition to the available ones and are being put into operation.

The ministry is focusing special attention on the rapidly developing gas-extracting region of the northern Tyumenskaya oblast and the Komi ASSR. Construction of agricultural objects is underway at accelerated rates in Uzbekistan, the Saratovskaya and Orenburgskaya oblasts, and other regions of extraction and transport of gas.

This year it is planned to utilize capital investments for agriculture of the branch totaling 16.7 million R and to put into operation pig sties for 15,000 head, poultry yards for 144,000 laying hens, cow barns for 400 head and greenhouses of 94,000 m^2. In order to accelerate construction of agricultural objects in the URS of the all-union production association "Tyumengazprom" a construction trust has been set up and is operating. In Tyumen' a plant is being built for production of wall panel for animal husbandry buildings, cafeterias and stores. The products of the plant will make it possible to sharply increase industrialization of construction of these objects, and accelerate the periods for their putting into operation.

It is necessary to take measures for a considerable strengthening of the material and technical base of the construction organizations, to increase the level of industrialization, and to use more economical materials and designs. One of the most important tasks today is to provide the construction organizations with qualified personnel, to direct towards these organizations more engineers, technician-builders and other specialists.

Construction of greenhouses based on heat of the exhaust from gas turbine engines of compressor stations has become widespread. Such greenhouses are being built at the enterprises of Mostransgaz, Sred-Aztransgaz, Uraltransgaz and others.

Today the heat of exhausts of gas turbine engines is still used little, and the cold which can be obtained in gas reduction at the compressor stations and gas distributing stations isn't used at all. In the settlements where the gas workers live, especially in areas removed from the industrial centers there are free labor resources which can be used to organize subsidiary farms.

The creation of greenhouse-vegetable kombinats near the compressor stations based on the use of secondary resources of heat is an important national economic task whose successful solution will make it possible to meet the needs of the population for vegetables for the entire year. Moreover, this is an exceptionally profitable matter. According to the data of specialists of the subsidiary farm of "Tumengazprom" the cost of 1 kg of vegetables raised in greenhouses where the heat of exhaust is used is almost 1 R lower as compared to those grown in standard greenhouses. For example, in the greenhouses of the settlement Komsomol'skiy the net cost of 1 kg of vegetables is 1 R 69 kop, while in Igrim--2 R 58 kop. However the leaders of the associations are still poorly involved in construction of greenhouses using the heat of exhaust of gas turbine engines of compressor stations.

The question of using the eddy effect of cooling in gas reduction is important. According to the calculated data the cold-output with the use of this effect on natural gas is almost three times greater than under conditions of standard throttling of gas. The experimental operation of a cooler with capacity of 12 T constructed in 1970 at the Ostrogozhsk compressor station indicated the high efficiency and reliability of this operation, and confirmed the practical possibility of creating at each compressor station and gas-distributing station coolers for storing meat, fruits, vegetables and other food products. Here, whereas the cost of a standard cooler with capacity of 12 T according to the model project of Giprokholod [State Institute for the Planning of Cold Storage Plants, Ice Cream Factories and Dry Ice, Ice and Liquid Carbon Dioxide Plants] is 12,400 R, the cost of an eddy cooler of the same capacity is 6,300 R. A great saving is achieved in the operation of the cooler both due to the simplicity of maintenance and the saving of electricity of over 57,000 kwh per year.

Each compressor station, each field, each of our plants, especially if they are located far from industrial centers must have complex subsidiary farms. We have unused potentialities and reserves and we must see that the cafeterias, snack bars, kindergartens and nurseries, and hospitals are provided with meat, milk, eggs, vegetables year round from their subsidiary farms.

In relation to the growth in stock of animals and poultry complexities with feed arise. An important source of additional feed is collection of food wastes at the enterprises of public nutrition and from the population.

In 1978 food wastes comprised over 30% of the feed ration of animals. The experience of the leading farms of the country demonstrates that this is little.

In the current year the URS and ORS [Department of Workers' Supply] have been set the task of collecting food wastes with regard for considerable increase in their percentage in the feed ration of animals. It is necessary to search on the spot for possibilities of strengthening the feed base by developing new land tracts and other sources.

The sovkhozes, subsidiary farms and swine-feeding stations are still poorly equipped with agricultural machines and equipment. The low level of mechanization in the final analysis reflects on the net cost of the product. In 1978 the net cost of 1 centner of increase in weight of a pig according to Soyuzgazurs was 163 R. The lowest net cost was attained in the URS of the association "Tyumengazprom," and the highest in the URS of the association "Komigazprom."

Soyuzgazurs jointly with URKTiZ should thoroughly generalize the accumulated experience of operating subsidiary farms, determine the best organizational forms, and adopt measures for their widespread.

The administration for organization of labor and wages needs to constantly perfect the system of stimulating farms that achieve high indices in production of agricultural products. It is necessary to develop additional measures to intensify material incentive for workers employed in producing agricultural products and who have achieved good results, and to improve the system of rewarding leaders and specialists of farms.

All the organizations and enterprises of the ministry must thoroughly analyze the situation with respect to subsidiary rural farms, and precisely define what and on what schedules each collective must do, in order to fulfill the decisions of the July (1978) Plenum of the CPSU Central Committee with good indices.

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PIPE NEEDS FOR MAJOR REPAIR DETERMINED

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 20-21

[Article by Yu. A. Avveyev, L. Z Dvorkin, V. N. Kolodin, V. I. Mayzel' (Ministry of the Gas Industry, VNIIEgazprom): "Determination of Need for Pipes and Major Repair of Gas Pipelines"]

[Text] The proposed method for determining the need for pipes for major repair of trunk gas pipelines can be used to compile long-term plans for the development of the gas industry.

At the modern stage of development of the gas industry in addition to the annual growth in length of trunk gas pipelines a necessary condition for increasing the effectiveness of gas transport is the correct organization of the operation, major repair and replacement of the linear section of active gas pipelines. Substantiated schedules and volumes of repair work and replacement of the linear section make it possible to set up precise planning of repairs--to provide the repair-construction services in advance with the program of work, and to provide for the necessary financing, supply of equipment and materials.

Table 1. Structure of the Need for Pipes for Major Repair of Linear Section of Trunk Gas Pipelines According to Diameters for 1976-1980 (in km)

Diameter mm	Pressure, kg-f/cm^2	Years				
		1976	1977	1978	1979	1980
1420	75	—	—	100	129	126
1220	55	111	75	152	171	174
1020	55	211	119	56	88	102
820	55	69	32	7	4	7
720	55	119	145	55	21	48
530	55	60	70	9	9	10

It is recommended that the time for conducting major repair and forecasted volumes of pipe supply to repair work be adopted based on the practical experience of operating gas pipelines and a natural aging of the insulation coating, and precisely: for gas pipelines with bituminous-rubber insulation not more than 11 years, with film insulation executed under field conditions no less than 17 years (for the central regions).

In repairing the linear section of gas pipeline the defective sections of pipe are partially replaced (in different volumes) depending on the natural and climate conditions, the degree of corrosive activity of the soils and so forth. From the experience of conducting repair work it is known that the need for pipes for replacing defective segments is on the average 10-20% the length of the section to be repaired.

Based on this calculations were made of the need for pipes for major repair of a linear section of trunk gas pipeline with respect to diameters depending on the periods for their putting into operation, conditions of construction and operation (Table 1). It was established that in the current five-year plan the need for pipes for major repair of gas pipelines of diameter 1,220 and 1,420 mm is significantly increasing.

From the cited approximate structure of the need for pipes for major repair of the linear section of gas pipelines for the future (Table 2) it follows that a large specific weight in the total need for pipes is gas pipelines of diameter 1,220, 1,020, 720 and 530 mm.

The proposed method for calculating the need for pipes for major repair of the linear segment of trunk gas pipelines for the future takes into consideration the actual periods for putting into operation the gas pipelines and branches, as well as the peculiarities of operation of the gas pipelines with bituminous-rubber and film insulations.

In determining the volume of pipes of major repair for the future it is necessary to provide for the factors that increase the reliable functioning of the gas transport systems: increase in the quality of planning and construction, timely conducting of major repairs of the linear section, use of more durable insulation coatings, including plant manufacture, guarantee of the normal operating conditions and so forth.

The implementation of the listed measures will promote the prevention of premature wear and malfunctioning both of individual elements and of the system as a whole.

The need for pipes to replace the linear section should be established on the basis of forecasts of the necessary renovation of gas pipelines, data about their durability determined by design features, the effect of wear on the technical and economic indices with lengthy functioning of the gas pipelines, and also taking into consideration the plan of gas flows.

Table 2. Structure of Need for Pipes for Major Repair of Linear Section of Trunk Gas pipelines According to Diameters for the Future

Diameter, mm	Pressure, kg-f/cm^2	Specific Weight in Total Need for Pipes, %
1420	75	12
1220	55	24
1020	55	27
820	55	3
720	55	18
530	55	16

Currently the amortization period for the service of trunk gas pipelines is taken as equal to 33 years. Based on this and on the basis of information about the periods of operation of gas pipelines forecasting volumes of pipes are calculated that are necessary for replacing the linear section, and which are the basis for the formulated plan of development of the branch up to 1990.

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FUELS AND RELATED EQUIPMENT

HEAT RECOVERY AT COMPRESSOR STATIONS

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 p 21

[Article: "Systems for Recovery of Secondary Energy Resources of Compressor Stations"]

[Text] The gas industry in guaranteeing extraction and transport of natural gas, at the same time is a major consumer of this fuel. Over 7% of the extracted gas is consumed for in-house needs of the branch. Therefore an increase in the effective use of fuel gas is an urgent problem.

One of the ways of solving this problem is recovery of heat of exhausts of the gas turbine engines [GTU] at compressor stations of trunk gas pipelines.

The dissertation work of Yu. S. Osered'ko for the scientific degree of candidate of technical sciences treated research in this direction.

As a result of the conducted research a new direction was substantiated and developed for recovery of heat of the exhausts of GPA gas turbine engines of compressor stations for heating oil in pumping along oil pipelines laid parallel to the trunk gas pipelines.

For the first time a technique was proposed for determining the economically expedient radius of heat transport from the compressor station to the point of oil heating.

A technique and algorithm were formulated for selecting the optimal parameters of the oil pipeline with the recovery units that make it possible to determine technical and economic effectiveness of the new method for pumping oil.

A technique was proposed for complex optimizing of the parameters of the recovery heat exchangers, tested by industrial experiments at active compressor stations. The findings were taken as the basis in the creation of a parametrical series of unified heat exchangers for all domestic gas pumping aggregates with gas turbine drive.

The results of the research were used by the institutes VNIIgaz (All-union Scientific Research Institue of Natural Gas) and Soyuzgazproyekt in the development of "method recommendations for recovery of waste heat of exhausts of heat engines of compressor stations for heating oil transported in oil pipelines." With the fulfillment of the institute VNIPItransgaz a draft experimental-industrial unit was manufactured for recovering heat of compressor stations in Beyneu for heating oil piped along the oil pipeline Uzn'-Kul'sary-Kuybyshev.

Based on the results obtained in the work the Soyuzgazproyekt, VNIIgaz, Institute of Technical Thermal Physics of the Ukrainian SSR Academy of Sciences, the Shchekino plant for repair of production equipment (RTO) and the all-union production association "Ukrgazprom" developed, tested and introduced new highly efficient heat exchangers for the aggregates GTK-10 and GTN-6.

The industrial test demonstrated that heat removal in the new heat exchangers was increased 1.9-fold, while the specific metal consumption per unit of generated heat was reduced 1.8-fold as compared to the previously manufactured designs.

Series production of the new heat exchangers was developed at the Shchekino plant RTO. The annual economic effect for their introduction and compressor stations of trunk gas pipelines equipped with gas turbine GPA GTK-10 and GTN-6 is over 1 million R.

For the first time in the gas industry a heating device was developed, tested and introduced with the participation of the Institute of Gas of the Ukrainian SSR Academy of Sciences for recovery heat exchangers that guarantee heat supply when the compressor station stops and excludes the need for construction of a reserve boiler house.

The heat device has successfully passed industrial testing and has been adopted for series production.

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SUCCESSFUL HIGH-SPEED DRILLING AT WEST KRESTISHCHENSK FIELD

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 22-24

[Ye. F. Zubkov, E. M. Arutyunyan, B. T. Bunyak, M. G. Plishka, and N. N. Mel'nik (UkrNIIgaz, Ukrburgaz): "Exploratory-Technological and High-Speed Drilling at West Krestishchensk Field"]

[Text] The experience of making the high-speed well 214 that reached commercial velocity of 1,027 m/st.-month, indicates the paths and reserves for the further increase in the rates of drilling, and the direction for conducting research on optimizing the drilling process.

The West Krestishchensk gas field is one of the largest in the Ukraine. It has been developed since 1971. Intensive drilling of the field has become a good basis for perfecting and optimizing the production process of making wells. Annually here 1-2 exploratory-technological and high-speed (OTiS) wells are made, whereby the tasks of these two categories of wells at times are combined, i.e., at the same time the goal is followed of obtaining the necessary volume of information and achieving a new and higher limit of speed.

Table 1. Comparative Technical and Economic Indices of Drilling Exploratory-Technological and High-Speed (OTiS) Wells at Krestishchensk Field for 1974-78

Indices	1974		1975		1976		1977		9 mos. 1978	
	OTiS No 123, 125,205	I_{av}	OTiS No 157, 156,166, 163	I_{av}	OTiS No 197, 202,192, 172	I_{av}	OTiS No 240, 132	I_{av}	High-Speed well 214	I_{av} (without well 214)
(1) Средняя глубина скважины, м	3867	3819	3662	3831	3705.5	3774.8	3736.5	3669	3800	3760
(2) Продолжительность бурения, ст.-мес.	6.35	9.54	6.37	7.84	4.9	6.87	4.7	7.05	3.7	7.2
(3) Коммерческая скорость (по законченным скважинам), м/ст.-мес.	609.0	400.2	670.8	534.6	756.2	548.7	795.0	520.0	1027	521.2

(4) Число долбежей	87,0	102,0	75,4	89,78	72,0	81,8	63,0	76,5	62	87
(5) Проходка за долбление, м	44,5	37,7	51,49	42,67	51,46	46,13	59,3	47,96	61,3	63,2
(6) Механическая скорость, м/ч	3,56	3,23	3,08	3,22	4,51	3,17	4,0	3,12	4,05	2,4
(7) Рейсовая скорость, м/ч	2,23	2,02	2,17	2,09	2,86	2,10	2,66	2,13	3,0	1,95
(8) Производительное время, %	84,5	68,8	85,4	73,0	84,6	84,3	84,0	74,9	95,9	84,6
(9) Фактическая стоимость, тыс. руб.	820,6	776,4	555,0	639	550,1	639,7	417,9	657,8	476,1	611,0

Key:
1. Average depth of well, m
2. Duration of drilling, st.-month
3. Commercial velocity (according to finished wells), m/st.-month
4. Number of slottings
5. Drilling footage for slottings, m
6. Mechanical velocity, m/h
7. Scheduled velocity, m/h
8. Productive time, %
9. Actual cost, 1000's R

Note. I_{av}--average value of indices for field

Table 2. Using Up Bits on Well 214

(1) Интервал бурения, м		(4) Тип и размер долот	(5) Число долот, шт.	(6) Средние показатели работы долот				(7) Параметры режима бурения			
(2) от	(3) до			(8) Проходка, м	(9) Время механического бурения, ч	(10) Механическая скорость, м/ч	(11) Рейсовая скорость, м/ч	(12) Нагрузка на долото, т	(13) Скорость вращения ротора, об/мин	(14) Производительность промывки, л/с	(15) Давление циркуляции, кгс/см²
0	240	Д394М (17)	1	240	8,0	30	19,3	(16) До 8	80—90	62—64	60
0	310	Д394М (17)	1	310	13,33	23,2	19,7	До 8	80—90	62—64	65
240	530	2У295М (18)	1	290	7,0	41,4	22,7	До 10	120	62—6.	75
310	550	1У295МГ (19)	1	240	7,33	32,7	20,7	До 8	120	50—52	60
530	970	1У295СГ (20)	4	110	10,0	11,0	8,2	До 10	120	62—64	75
550	963	1У295МГ (19)	1	413	15,25	27,1	21,1	До 8	120	50—52	70
970	1280	2У295С (21)	3	103,3	10,0	10,3	7,2	13—15	120	54—56	110
963	1413	1У295МСГ (1) (21b) 111У295,3 СГВ (2) (22)	3	150	14,05	10,7	8,2	8—12	120	50—52	80
1280	1580	2У295МСГ (18b)	3	100	10,0	10,0	6,5	12—14	120	54—56	110
1413	1593	111295,3 МСГ (23)	2	90	19,75	4,5	3,75	До 12	120	50—52	80
1580	2180	295,3 СЗГ (24)	10	60	10,0	6,0	3,8	20—22	120	48—50	120
1580	2170	295,3 СГВ (25)	12	48	14,05	3,4		16—18	120	50—52	90
		295,3 СГВ (25)	6	50	18,65	2,7	2,22	16—18	120	—	—
		295,3 СЗГВ2 (26)	1	108	11,58	9,33	6,51	16—18	120	—	—
		295,3 СГВ (25)	1	3	4,0	0,75	0,42	16—18	120	—	—
		295,3 СГВД (27)	1	22	7,92	2,8	1,93	16—18	120	—	—
		295,3 СГВ (25)	3	48,0	11,06	4,34	3,15	16—18	120	—	—
2180	3060	215,9 СГВ (28)	15	52,0	10,0	5,2	3,1	18—22	80—90	40—42	120
2170	3056	215,9 СНВШ (29)	14	63	16,4	3,86	2,9	18—20	80—90	40—42	100
3060	3500	215,9 СГВ (28)	11	40,0	12,0	3,3	1,85	18—22	80—90	40—42	До 130
3056	3559	215,9 СГВ (28)	16	31,4	16,6	1,9	1,43	18—22	80—90	40—42	110
		215,9 СГВШ (29)	15	31,8	16,7	1,9	1,45	18—22	80—90	40—42	110
		215,9 СГВМД (30)	1	14,5	14,5	1,8	1,40	16—18	80—90	40—42	110
3500	3800	215,9 СГВ (28)	10	30	15,0	2,0	1,15	18—22	80—90	40—42	До 140
3559	3800	215,9 СГВШ (29)	23	20	14,76	1,36	0,96	16—18	80—90	24 -26	До 100
0	3800		58	65,5	11,14	5,97	3,4				
0	3800		62	61,3	15,13	4,05	3,0				

Key:

1. Interval of drilling, m
2. From
3. To
4. Type and size of bits
5. Number of bits
6. Mean indices of bit operation
7. Parameters of drilling pattern
8. Drilling footage, m
9. Time of mechanical drilling, h
10. Mechanical velocity, m/h
11. Scheduled velocity, m/h
12. Load on bit, T
13. Rate of rotation of rotor, rpm
14. Output of washing liquid, l/s
15. Pressure of circulation, kg-f/cm^2
16. To
17. D394M
18. 2U295M 18b. 2U295MSG
19. 1U295MG
20. 1U295SG
21. 2U295S 21b. 1U295MSG
22. 111U295.3SGV (2)
23. 111295.3MCG
24. 295.3SZG
25. 295.3SGV
26. 295.3SZGV2
27. 295.3SGVD
28. 215.9SGV
29. 215.9SNVSh
30. 215.9SGVMD

Note. Half-dark type indicates actual indices, light--according to RTK

Table 3. Comparative Analysis of Balance of Calendar Time, %

(1) Показатели	(2) Все календарное время	(3) Производительное время							(12) Ремонтные работы	(13) Непроизводительное время		
		(4) Работы по проходке			(9) Крепление	(10) Подготовительные и вспомогательные работы	(11) Всего		(14) Простои	(15) Аварии и брак	(16) Всего
		(5) Всего времени	(6) в том числе (7) механическое бурение	(8) СПО							
Скв. 214 (17)	100	47,8	35,0	12,8	21,0	27,1	95,9	3,3	0,8	—	0,8
В целом по Западно-Крестищенскому месторождению за 9 мес. 1978 г. (18)	100	40,1	27,1	13,0	17,3	27,2	84,6	5,7	5,9	3,8	9,7

Key:

1. Indices
2. Entire calendar time
3. Productive time
4. Work on drilling passage
5. Entire time
6. Including
7. Mechanical drilling
8. Hoisting operations
9. Securing
10. Preparatory and auxiliary work
11. Total
12. Repair work
13. Nonproductive time
14. Idle time
15. Accidents and defects
16. Total
17. Well 214
18. On the whole for West Krestishchensk field for 9 months of 1978

The dynamics of growth in the technical and economic indices of OTiS of drilling from 1974 and the effect of the experience and results of drilling of these wells on the general level of indices for the field is graphically illustrated in Table 1. Thus, whereas in 1974 for OTiS wells the commercial rate of drilling was 609 m/st.-month, and the cost of one well 620,600 R, in 1977 these indices reached respectively 795 m/st.-month and 417,900 R.

In the process of working out the planned experiments on OTiS wells in 1976-1977 for each of the sets of rocks the dependence was established for the mechanical rate of drilling on the load on the bit and the number of its revolutions. Practically for the entire cross section the mechanical rate rises faster from the increase in axial load than from the increase in the number of bit revolutions.

The turbine method of drilling can compete with the rotary method in the persalt cross section, further slow-speed drilling becomes much more preferable. In 1978 at the West Krestishchensk field high-speed well 214 was made. Before the beginning of drilling the UkrNIIgaz Ukrainian Scientific Research Institute of Natural Gas jointly with the technological and dispatcher services of the production association "Ukrburgaz" developed a technological plan for making the well from a calculation of reaching commercial velocity of drilling of no less than 900 m/st.-month.

With respect to the mining and geological conditions the cross section of the well was conditionally divided into three intervals: persalt, uniting the terrigenous deposits from the Quaternary to the upper Permian inclusively (0-2180 m), chemogenous (2180-3060 m) and subsalt represented by the terrigenous formations in the lower Permian and upper Carboniferous (3060-3800 m).

During drilling of the wells it was expected: absorption of the drilling solution in the Quaternary, Tertiary and Cretaceous deposits, sandy-argillaceous formations of the Jurassic period, Triassic and upper Permian, as well as in the lower Carbonaceous (in the developed productive bed); rock wastes and cave-ins in the Quaternary and Tertiary deposits; constriction of the shaft in the marlaceous-cretaceous series; oil seal formation in the argillaceous cross section of the Triassic; cavern formation in the chemogenous series; manifestation of gas from the productive cross section, as well as natural bending of the well.

In order to achieve the planned velocity it was necessary to prevent the aforementioned complications, optimize the pattern parameters of drilling, use higher quality drills based on their efficient interval-by-interval use, not tolerate the content in the drilling solution of an excess solid phase, and constantly maintain the optimal values of its parameters.

The program for implementing the drilling of well 214 also provided for organizational-technical measures for the maximum increase in productive time and improvement in the structure of the balance of the latter; constant engineering

control over drilling of the well and strict technological discipline in the drilling brigade.

Besides fulfillment of the task for obtaining a record velocity in drilling the well it was also stipulated that a number of scientific research works be conducted to establish the dependence of mechanical and scheduled velocities of drilling on the content of solid phase in the drilling solution, output of washing fluid, load, velocity of bit rotation, type of bit and so forth.

Since one of the decisive factors for achieving the established tasks is an increase in the effective operation of the bits, this question was given primary importance. The entire cross section of the well was divided into nine stratographic-lithological complexes (members) of rocks according to drillability. The principle of lithological uniformity of rocks and approximately the same drillability was the foundation for isolating the members.

The well was planned for drilling by rotary method for the entire cross section with the help of the drill "Uralmash-4E-67." As the drilling tool pipes of type TBVK-140 mm and UBT-203 mm were used in the interval 0-2170 m and TBVK-140 mm, LBT-127 mm, TBVK-127 mm and UBT-146 mm (with locks) in the interval 2170-3800 m. The use of the LBT-127 mm (with length up to 1700 m) made it possible to significantly reduce the time of the hoisting operation and increase the scheduled velocity of drilling.

The well was started by drilling 11 May 1978 and was successfully completed by drilling 30 August 1978. The actual commercial rate was 1027 m/st.-month, which was a record not only for the West Krestishchensk field, but also for areas of the Dnepr-Donetsk basin that are analogous in depth and cross section.

Table 2 gives the actual data on using up bits in comparison with the expected indices provided for by the pattern-technological chart (RTK) of the technological plan for making the well. As is apparent from the table, the actually employed types of bits mainly correspond to those provided for in the RTK. As for the pattern parameters of drilling and washing, for different reasons in certain intervals the actual axial loads on the bit and output of washing fluid were somewhat lower than the planned. Nevertheless the actual mean drilling footage per bit as a whole for the well is only slightly inferior to that provided for by the RTK (61.3 and 65.5 m respectively). At the same time the average actual time that the bit was in the bottom hole was significantly higher than that provided in the RTK. The mechanical and scheduled velocities of drilling were respectively lower, however they significantly exceed both the standard and that previously attained at the field.

A lot of attention was focused on the question of cleaning the drilling solution, in particular the content of solid phase in the solution was controlled. However due to the lack of highly efficient cleaning devices the cleaning of the solution nevertheless leaves something to be desired.

Table 3 gives a comparative analysis of the balance of the calendar time of well 214 and for the field as a whole in the 9 months of 1978. Besides the fact that for well 214 the percentage of productive time is considerably higher, one is struck by the significant improvement in the structure of the balance, in particular, the time has been increased that is spent directly on drilling footage.

The experience of making the OTiS wells in the West Krestishchensk field make it possible to draw the following main conclusions:

1. Drilling of the exploratory-technological and high-speed wells at the West Krestishchensk field significantly affected the increase in technical and economic indices of drilling as a whole for the field.

2. There are significant possibilities and reserves for a further increase in all the main technical and economic indices in drilling subsequent wells at the West Krestishchensk field in the first place due to:

effective selection of types of drills with respect to the intervals of depth, use of high-quality and highly productive bits;

further optimizing of the pattern parameters of drilling and washing, and primarily the use of high axial loads on the bit;

improvement in cleaning the drilling solution and maintaining the minimum content of solid phase;

prevention of possible complications, accidents and organizational idle time;

further improvement in the balance of time and structure of the actual productive time primarily by reducing the time for preparatory-auxiliary work and work to secure the well.

3. The possibilities for improving the selection and using up of bits have far from been exhausted and need further study and perfection.

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ARTIFICIAL COLD UNIT PROVES TO BE MORE EFFICIENT

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 25-26

[Article by M. D. Buleyko, A. M. Starodubtsev, V. G. Podyuk, I. I. Kharin (Komi department of VNIIgaz, all-union production association "Komigazprom," Vuktyl' Gas Field Administration): "Operation of Artificial Cold Unit"]

[Text] At the Vuktyl' gas condensate field the gas is prepared according to the plan of low-temperature separation by means of gage formation pressure in the starting period of development with subsequent putting into operation of artificial cold units.

In 1977 at the UKPG-1 whose wells have the lowest formation pressure an artificial cold unit was put into operation on four steam-compressor propane machines based on gas motor compressors type 10 GKN 2/2.5-17. The cold units at UKPG-2, 3, 4 and 5 are in the stage of construction.

In accordance with the plan the gas of each of the three blocks of UKPG-1 after the first stage of separation and heat exchangers "gas-gas" enters through the common gas collector into two evaporator-coolers (see figure) where it is cooled to the assigned temperature. Then the gas is returned on another collector to UKPG-1, it passes the second stage of separation, heat exchange apparatus, the third stage of separation, and is fed along the intra-field gas collector to the main buildings where it is subject to additional purification, and is sent through the measuring point to the trunk gas pipeline Vuktyl-Ukhta-Torzhok.

Below certain questions are examined of gas preparation using the cold of a steam compressor cooling unit included in the production plan of UKPG-1.

In the period of investigating the operating pattern of UKPG-1 two blocks with volumes of gas extraction respectively 185,000 and 168,000 m^3/h were connected to the evaporator-coolers of the unit. The purpose of the conducted studies was to record the extant operating pattern of the unit, analyze the findings and select the optimal operating pattern of UKPG-1 with the artificial cold unit.

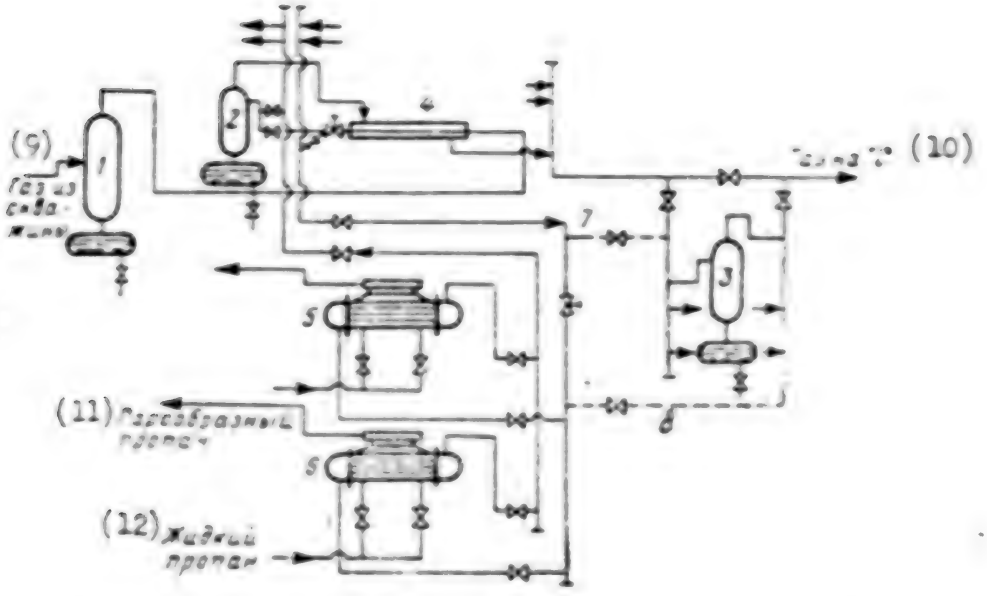

Figure. Technological Plan of Gas Preparation at UKPG-1 [Unit of Complex Gas Preparation] of Vuktyl' Field

Key:

1, 2, 3	Separators of first, second and third stages of separation
4.	Heat exchanger "gas-gas"
5, 6	Evaporator and cooler respectively
7, 8	Lines of proposed switching of separators of third stage
9.	Gas from well
10.	Gas to GS
11.	Vaporous propane
12.	Liquid propane

In the period of investigation two steam compressor machines were in operation, and the gas was cooled in four evaporator-coolers (two for each block).

The temperature of the gas coming in for cooling was maintained at the exit from UKPG-1 at 0.5-2°C, and at the entrance to the evaporators-coolers--from 1 to -1.5°C. At the exit from them the temperature was -15-17°C, and at the entrance to the separators of the second stage -14-15°C, which corresponded to the temperature of separation. This is explained by the heat exchange of the uninsulated collectors.

The temperature of the separated gas at the exit from the heat exchangers "gas-gas" was -5.5-7.5°C. The incomplete recovery of cold was on the order 25°C, which is 10-12°C higher than the average for the entire UKPG of the field, i.e., the incomplete utilization of cold for the two blocks reached 1.5 x 10^6 kcal/h.

In the operation of the UKPG-1 blocks without the cooling unit when gas was cooled only by means of the gage drop in gas pressure on the throttling devices, the weighted average temperature of separation in the first and second blocks was respectively -8.8 and 9.2°C. Consequently, if one starts from the level of gas cooling -15°S, then to guarantee such a temperature by the two blocks with the current gage gas pressures the entrance to the UKPG-1 it is necessary to consume an additional 1.25×10^6 kcal/h of cold, which corresponds to the operation of one steam compressor machine 10 GKN 2/2.5-17.

In the majority of production lines pressure at the input to the UKPG-1 exceeds the working pressure of the evaporator-coolers by 15-40 kg-f/cm^2. This makes it necessary to reduce gas pressure after the first stage of separation to 60 kg-f/cm^2, which results in condensation of the heavy hydrocarbons in a quantity of 15-20 g/m^3, which together with the gas enter the evaporator-coolers. According to the data of calculations the cooling of the condensed liquid requires an additional 490×10^3 kcal/h of cold.

Each UKPG-1 block was connected to two evaporator-coolers autonomously. If one takes into consideration that all the UKPG-1 blocks operate with a load that varies with respect to g[illegible], while the evaporator-cooler were connected by propane to a collector that is common for all the machines it becomes evident that the extant plan of connection of the blocks does not guarantee uniform loading of the evaporator-coolers and reduces the cold productivity of the unit.

Conclusions

With the extant operating pattern of the UKPG-1 and cold station for cooling gas in a volume of 348×10^3 m^3/h in the evaporator-coolers up to -17°C on the order of 2×10^6 kcal/h of cold are consumed. Here due to the incomplete recovery of cold of the separated gas in the heat exchangers about 1.5×10^6 kcal/h of cold are irreversibly lost.

Gas cooling to temperature of -15°C with current pressures at the entrance to the UKPG-1 can be guaranteed during the operation of one steam compressor machine. Here at the UKPG-1 it is necessary to recover the cold of the entire volume of separated gas.

In order to separate the liquid that has been condensed after the first stage of separation with a decrease in gas pressure to 60 kg-f/cm^2 in the technological plan of the UKPG the third stage of separation can be used as an additional stage before the evaporator-coolers. For this it is necessary to execute insignificant switches which are shown in the figure by dotted lines.

At the newly constructed cooling units of other UKPG of the Vuktyl' field it is recommended that the blocks be connected to the evaporator-coolers by common collectors. Here the collector of the "cold" gas should be thermally insulated.

In planning the artificial cold units at the fields with high content of condensate it is necessary to provide for installation of separators at the input of the gas to the evaporator-coolers.

The fulfillment of the listed measures will guarantee uniform loading of the evaporator-coolers and reduction in the losses of cold by 1.9×10^6 kcal/h at all the UKPG of the field, which is equivalent to the output for cold of two machines 10 GKN 2/2.5-17.

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DR-12 GAS ENGINE COMPRESSORS SUGGESTED FOR WORKING GAS FIELDS

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 26-27

[Article by V. G. Kozlov (VNIPIgazdobycha): "Outlook for Using Gas Engine Compressors DR-12"]

[Text] For the greatest recovery of gas supplies on fields with declining extraction machines of type DR-12 can be successfully used whose plan of multiple-stage compression is designed for complete working off of the beds.

Currently for complete working off of gas fields with gas extraction of 10-20 billion m^3 per year superchargers are used with drive from gas turbine units with capacity 6,000 kw. Mainly these are 1-stage superchargers with drive from the gas turbine units GT-6-750 and GTN-6.

As demonstrated by the practical operation in a pattern of complete working off of such fields like Gazliyskoye, Achakskoye, and Naipskoye, the use of 1-stage superchargers for complete working off of these fields resulted in the creation of a large number of stages of compression.

The use of 1-stage superchargers governs the work of a group of superchargers in series, i.e., the work from supercharger to supercharger. This complicates the technological plan of the field, since the malfunction of the compressor aggregates in one group results in the reconstruction of operation of the aggregates in other groups, i.e., practically the reduction and even possible halt in gas supply to the main gas pipeline.

Shortcomings in the use of 1-stage superchargers are especially manifest in the period of declining extraction from the field, i.e., when in addition to pressure the recovery of gas also begins to decline. In this respect it becomes necessary to increase the degree of compression, and this involves the increase in the number of superchargers connected in series. At the same time since the recovery from the field is reduced, and consequently, the output of the compression compressor station is reduced, power is released in the groups of superchargers connected in series, which is expressed in underloading of the supercharger drive in groups for release of individual superchargers.

The elimination of the aforementioned shortcoming is possible on the condition of creating multiple-stage superchargers, whose degree of compression is designed for complete working off of the field, i.e., based on the minimum pressure by the end of working of the field.

The multiple-stage supercharger must provide gradual increase in the degree of compression with the preservation of the nominal load of its drive.

Currently the design and production work on creating multiple-stage superchargers is going very slowly, while already in the near future it will become necessary to plan compressor stations for such fields as Shatlyk, Mubarekskaya group of fields and so forth.

Taking into consideration the state of development of the design of multiple-stage superchargers the use for complete working off of fields with annual gas recovery of 10-12 billion m^3 of the gas engine compressors DR-12 is very promising; they are currently being developed by the Gor'kov plant "Dvigatel' Revolyutsii."

At the field structures the stages of the compression compressor station based on the normal operation of units for gas preparation to further transport, as a rule, should be arranged both after and before the units of gas preparation. At the same time the minimum gas pressure necessary for feeding it to the trunk gas pipelines with pressure 56 kg-f/cm^2 is 35-40 kg-f/cm^2, and with pressure 76 kg-f/cm^2--45-52 kg-f/cm^2. Such pressure with regard for losses at the units of gas preparation to further transport is guaranteed by the modification of gas engine compressors DR-12/(35-45)-56 and DR-12/(35-52)-76 developed by the plant "Dvigatel' Revolyutsii." Consequently, in order to guarantee complete working off of fields it is necessary to create modifications of the gas engine compressors DR-12 that guarantee compression of gas before the units of gas preparation with final pressures 40 and 52 kg-f/cm^2 depending on the working pressures in the trunk gas pipelines.

It is expedient to create the following modifications of gas engine compressors DR-12; DR-12/(4-6)-(16-25); DR-12/(16-25)-(40-52); DR-12/(4-6)-(40-52).

The design of the gas engine compressors, as well as the plans for the compression compressor station must guarantee the transition from one modification to another under conditions of the active compressor station with minimum outlays.

The creation of the aforementioned modifications of gas engine compressors DR-12 will make it possible to guarantee their in-series connection and nominal load with respect to power up to the end of working of the field, as well as high reliability and technical-economic effectiveness of gas transport from the fields in the period of their compressor working.

GROZNO OIL INSTITUTE CELEBRATES 50TH ANNIVERSARY

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 7, Jul 79 pp 58-59

[Article: "50th Anniversary of Grozno Oil Institute"]

[Text] In July 1979 the oldest oil higher educational institute in our country the Academician M. D. Millionshchikov Grozno Order of the Red Banner of Labor Oil Institute celebrated its 50th anniversary. During these years the institute graduated about 20,000 engineers: geologists, geophysicists, technologists, drillers, mechanics, builders and other specialists of the oil, gas, oil refining, petrochemical and other branches of industry of our country.

The editorial staff turned to one of the graduates of the institute, the head of the administration of leading personnel and educational institutions, member of the board of the Ministry of the Gas Industry P. M. Tonkonogov with the request to relate the glorious history of the Grozno Oil Institute and to answer questions that interest the readers.

[Question] Petr Mikhaylovich please tell us what were the prerequisites for creating the institute, the forge of specialists of the oil industry?

[Answer] Back in May 1920 immediately after the nationalization of the Grozno oil industry, when the central administration of Grozno oil field and plants (Nefteupravleniye) was set up, the question became acute of providing the oil fields and plants of Grozno with skilled workers, technicians and engineers. Of course they could not count on receiving the necessary specialists from other regions of the country at that time. Therefore the Grozno oil administration on 1 August 1920 opened in its system the higher oil technical school consisting of eight departments. Two departments, the mining-oil and petrochemical were called "higher" and had a group of auditors of 87. The task of these departments at the very beginning consisted of preparing engineers of narrow speciality for oil field and oil plant work.

In 1925 the technical school graduated its first engineers, and in 1929 a higher technical school was organized on its basis--the Grozno Oil Institute which since then has been acknowledged as a school for preparing engineers for the oil, gas and oil refining industry of the Soviet Union.

[Question] What was the role of the graduates of the Grozno Oil Institute in establishing and developing the domestic industry?

[Answer] The graduates of the institute today are working not only in all the corners of our motherland, but also abroad. They took and are taking the most active participation in discovering and developing oil and gas fields of the second Baku, west and east Siberia, Central Asia, Mangyshlak, Astrakhan Povolzh'ye, the north European sector of the USSR, the Ukraine, Belorussia, the North Caucasus, the Transcaucasus and other regions. At the same time the disciples of the Grozno Oil Institute actively promoted and are promoting the development of the oil and gas industry in countries of socialist cooperation and in the developing countries.

The graduates of the institute played a great role in establishing and developing the oil refining and petrochemical industry of the country.

The oldest higher educational institute in the country produced many talented leaders of party, soviet and economic organs. Among them is Viktor Stepanovich Fedorov, the minister of the oil refining and petrochemical industry of the USSR and Nikolay Alekseyevich Mal'tsev, the minister of the oil industry.

For especially leading achievements in science and technology many of the graduates of the institute have been awarded the Lenin and state prizes. These are Academician M. D. Millionshchikov, the former vice president of the USSR Academy of Sciences, whose name the Grozno Oil Institute bears, Academician A. A. Dorodnitsyn, director of the computer center of the USSR Academy of Sciences, professor of MINKhiGP [Academician I. M. Gubkin Moscow Institute of the Petrochemical and Gas Industry], A. I. Skobio and many others.

From the walls of the Grozno Oil Institute a whole series of leading scientists emerged who made a significant contribution to the development of individual branches of the oil and gas science and created their own scientific schools.

The scientific developments of the scientists of the institute, professors V. S. Fedorov, M. M. Aleksandrov, L. Ye. Simonyanets, and associate professor V. G. Belikov had and continue to have a significant effect on the questions of the theory and practice of drilling oil and gas wells with regard for the modern technical potentialities. Professors K. G. Orkin, K. M. Dontsov, and A. I. Guzhov made a significant contribution to the development of scientific research in the area of operating and developing oil and gas fields, and in the area of refining oil and gas--professors A. Z. Dorogochinskiy, V. I. Oborin, A. K. Seleznev, A. P. Grishin and others.

Professors G. M. Sukharev, P. P. Zabarinskiy, B. K. Lotiyev, S. S. Itenberg, M. N. Smirnova, and Yu. A. Sterlenko are the founders if one can speak thus of the Grozno School of Geologists who successfully solved the tasks of developing oil and gas geology not only in the Caucasus, but also in many other regions of the country.

For successful work on training personnel for the oil, gas and other branches of industry the institute was awarded the Order of the Red Banner of Labor.

Currently in the institute almost 6,000 students are studying, and at its 8 faculties engineers of 14 specialties are being prepared. The institute is made up of highly qualified scientists and specialists. At the 34 departments 390 people are working on the professorial-teaching staff, including 15 doctors of science and professors and 165 candidates of science and associate professors.

The extensive subjects of scientific research work conducted by the institute whose volume increases from year to year has a great effect on increasing the quality of training specialists.

[Question] It is known that the gas industry of our country thanks to the daily attention of the Communist Party and the Soviet government is developing at high rates. Formed in 1956 into an independent direction of the fuel and energy complex by now it has become a highly efficient branch of the socialist economy. Probably the graduates of the Grozno Institute made a considerable contribution to development of the gas industry?

[Answer] Undoubtedly. Many of them linked their labor fate to the gas industry. On the immense expanses of west and east Siberia, in Central Asia and Komi ASSR, in the Orenburgskaya oblast and in the Ural gas trunklines in Belorussian and the Ukraine, in the Transcaucasus and the northern Caucasus, in far off Yakutiya and in harsh Arctic one can encounter Grozno graduates who are developing with great creative enthusiasm the gas fields, are constructing and putting into operation new gas transport trunklines, and are persistently increasing the volumes of natural gas supplied for the needs of industry and daily life.

Such figures indicate how rapidly the gas industry of the Soviet Union is developing: whereas in 1955 only 9 billion m^3 of gas were extracted, in 1978 its extraction was 372 billion m^3. In level of annual (and five-year) increases in gas extraction the Soviet Union has surpassed all the countries of the world including the United States. Thus whereas in the Eighth Five-Year Plan the increase in gas extraction in the country was 70.3 billion m^3, in the Ninth 91.4 billion m^3, in the 10th Five-Year Plan in accordance with the decisions of the 25th CPSU Congress an increase in gas extraction of 146 billion m^3 will be provided.

In the 3 years of the 10th Five-Year Plan gas extraction exceeded the planned indices by 16.5 billion m^3.

In the country the unified system of gas supply is successfully functioning which is the largest in the world in capacity and power available per productive unit. The gas from the fields of the Russian Federation, Ukraine, Turkmeniya, Uzbekistan, Azerbaijan, Kazakhstan and Tadzhikistan travels along powerful underground arteries to the consumers of all the union republics.

Natural gas is widely used in the chemical industry, ferrous metallurgy, machine construction and metal working, and the industry of construction materials. It plays an exceptionally important role in the development of electrical power in the country. With each year the quantity of gas directed for the satisfaction of the daily needs of the Soviet people is increasing.

The Soviet gas workers are selflessly laboring in different corners of our motherland, often in complex natural and climate conditions, and are persistently fighting for the successful fulfillment of the planned assignment and socialist commitments of the 10th Five-Year Plan.

In speaking about the tasks of development of the branch, one should dwell also on the new direction of activity of the Ministry of the Gas Industry--exploration and development of offshore oil and gas fields.

The solution of enormous tasks of the further development of the gas industry is unthinkable without the continuous replenishment of our branch with highly qualified specialists, and in the first place engineers of gas and oil profile. Annually in the branch we receive 1,100-1,200 specialists with higher education of which roughly half are graduates of oil higher education institutions. They include those who graduated from the Grozno Oil Institute. In the years of the Ninth and 10th Five-Year Plans alone the branch received 350 engineers who are graduates of this oldest higher educational institution.

The absolute majority of people of are actively included in the production life of the collectives, becoming in the latter good organizers of production and active educators of the workers. Many of them are now leaders of large enterprises and associations. Thus, Ye. N. Altunin who graduated from Grozno Oil Institute in 1953 in the space of many years headed the branch's largest all-union industrial association "Tyumengazprom." In 1978 he was elected

secretary of the Tyumen' CPSU obkom. For several years another major all-union industrial association "Turkmengazprom" has been led also by a pupil of the Grozno Oil Institute, V. A. Talday, an engineer who graduated in 1955. Former students of the anniversary institute V. A. Mysyakin, D. Z. Markarov, V. Ya. Chumakov, A. A. Kasparov, V. Ye. Tolmachev and others are the heads of associations.

The graduates of Grozn Oil Institute are successfully leading the plants, production administrations, sections and shops. The excellent theoretical training, broad scope, solid knowledge obtained in the institute permit them to rapidly, on a high scientific and technical level solve the most complex tasks of modern production.

For all of this, graduates of the Grozno Order of the Red Banner of Labor Oil Institute the days that were spent in the walls of our own higher educational institute remain unforgettable. And we will be always grateful to it for our past to a great life.

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BRIEFS

SHIP REPAIR SERVICE--On 5 May of this years we published a satirical article under the heading "One Hundred Thousand Under the Keel." The editor has received a reply to this article from officials of the Sevastopol' Atlantika Production Association of the Fishing Industry, specifically from A. Shestakov, the general director, N. Alpatov, the secretary of the party committee and V. Svinolupov, chairman of the base committee. They report that the article was discussed at a meeting of the engineering and technical personnel and in the various shops of the plant. The criticism was acknowledged to be correct. Those persons who had neglected their work were strictly reprimanded. Ways were specified to improve the work of the ship-repair plant, and it was planned to organize socialist emulation to get ships repaired ahead of schedule. Other factors besides organizational inadequacies also had a negative effect on the repair of the Alsu RTM [marine fishing trawler?]. As a result of the relocation of a number of vessels from the Atlantic Ocean to the Pacific and the organization of fishing in the Black Sea by vessels of the "Tropik" type, the management of the Azcherryba VRPO [not further identified] and the Atlantika SPORP [not further identified] decided to accept orders for the repair of these vessels at the expense of other planned repairs, including those to the Alsu RTM. Four vessels not included in the plan were repaired. The speed of repairs is also negatively effected by the fishing fleet's lack of imported spare parts, and of certain sizes of pipes. There is only a 40-50 percent rate of satisfaction of the demand for imported spare parts, tools and accessories, and this is reflected to a certain degree in the time it takes to complete repairs. [Text] [Moscow VODNYY TRANSPORT in Russian 28 Aug 79 p 2] 8543

QUICK REPAIRS--Klaypeda--"We are going to sea two months ahead of schedule," said the telegram sent to Kalinigrad by the crew of the floating base named Baltic Glory. The success of the fishermen was rightfully shared by the ship repairers of Klaypeda. They repaired ahead of schedule the main engine and other parts. Members of the crew who were not on duty worked with them. Combining the efforts of sailers and repairers has become a good tradition here. The joint undertakings make it possible to significantly accelerate the rate of work. [Text] [Moscow IZVESTIYA in Russian 22 Aug 79 p 1] 8543

FISHING QUOTA MET--The collective of the 090 small fishing seiner was the first of ships' crews and on-shore enterprises of the base of the seiner fleet imeni Nadibaidze of the Primorskoye Production Association to report that it had met the production targets of the Tenth Five-Year Plan. /Text/ /Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 17 May 79 p 1/ 8543

SUPERTRAWLER UNDER CONSTRUCTION--The name of submarine hero I.A. Kolyshkin is recorded in the glorious battle chronicle of the Soviet Navy. During the Great Patriotic War he commanded a division and then a brigade of submarines of the Northern Fleet. The units which he led were responsible for the sinking of nine enemy ships. In January 1942 he was awarded the title of Hero of the Soviet Union. At the present time the Nikolayevka Okean Shipbuilding Plant is constructing a supertrawler for Murmansk fishermen; it will make peaceful runs for fishing purposes in the area of Soviet submarine action during the Great Patriotic War. The new ship has been given the name the Admiral Kolyshkin. /Text/ /Moscow VODNYY TRANSPORT in Russian 26 Jun 79 p 4/ 8543

OKA RIVER FISH--Orel--In recent years the Oka River has become rich in new species of fish. They include Lensk sturgeon and sterlet, which have been spotted in the inspection catches, which are conducted by the State Fish Inspectorate. Every year the Orel Sturgeon Plant, which began its existence in 1976, increases the number of two-year old fish which it releases into the Oka for fattening. /Text/ /Moscow SEL'SKAYA ZHIZN' in Russian 28 Feb 79 p 4/ 8543

COMPUTER FOR FISHING INDUSTRY--A second unit of an automatic control system has gone into operation at the Kaspryba All-Union Fishing Industry Association. It was developed and applied by the employees of the association's planning-design technological bureau. The flow of information, which comes here from the ships of the fishing and transport fleet and from fish-processing enterprises, is analyzed with the help of the Minsk-22 and Minsk-32 computers. The data which are obtained make it possible to significantly improve planning and the organization of the work involved in catching, transporting and processing the fish by the ships and production units of Kaspryba. /Text/ /Moscow VODNYY TRANSPORT in Russian 6 Jan 79 p 1/ 8543

DECREE ON FISHING DISCUSSED--LenTass--A meeting of the fishing industry aktiv was held yesterday to discuss measures to increase the output of fish products, the catch of marine and fresh-water fish and the breeding of fish by enterprises in Leningrad Oblast in light of decrees by the CPSU Central Committee and the USSR Council of Ministers on the development of the fishing industry. The meeting was opened by V. Ya. Khodyrev, secretary of the Leningrad Gorkom of the CPSU. A report was presented by V.P. Vorfolomeyev, head of the department of the light and food industry of the Leningrad Obkom of the CPSU. He noted that the collectives of Leningrad's fishing industry enterprises, fishing collectives, scientific-research and planning-design institutes are

definitely working to increase the catch and processing of fish, to expand the variety of fish available and to improve the quality of products made from them and to replenish fish stocks. The plans for the first three years of the five-year plan have been fulfilled. Fifty million cans of fish more than called for by the plan have been produced. New areas and facilities for catching fish in the ocean have been opened. Labor productivity at enterprises of the Northwest Fishing Industry Association has been increased by 14.5 percent. At the same time, however, the collectives of the Leningrad fishing enterprises and agencies are not meeting the targets for the development of the fishing industry in the current five-year plan. The targets set by the five-year plan for the catch of ocean fish have not been met. Considerable amounts of time are lost on ships, and the opportunities for fishing in the oblast's waters are not fully utilized. The speaker and those who participated in the discussions revealed that reserves do exist for the utilization of the productive capacities of the fleets, and they analyzed measures to reach --without fail--the plan targets for catching and processing fish. They also devoted attention to the mechanization and automation of the technological processes at enterprises. Consideratin was also given to the progress made by the collectives in fulfilling their obligations. The participants in the meeting adopted a resolution outlining concrete proposals aimed at ensuring that Leningraders are supplied with high-quality fish products. /Text/ /Leningrad LENINGRADSKAYA PRAVDA in Russian 2 Jun 79 p 2/ 8543

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